5 Take Minimization and Mitigation Measures

California Department of Fish and Wildlife (CDFW) incidental take permit (ITP) regulations require a description of the proposed measures to minimize and fully mitigate the impacts of the proposed take (14 CCR 783.2(a)(8)). This chapter describes the measures that the California Department of Water Resources (DWR) will implement to avoid, minimize, and mitigate impacts on species for which take authorization is being sought. These minimization and mitigation measures ensure that the impacts of the authorized take are minimized and fully mitigated and that such measures meet the following criteria (14 CCR 783.4(a)(2)).

- Are roughly proportional in extent to the impact of take on the species.
- Maintain the applicant's objectives to the greatest extent possible.
- Are capable of successful implementation.

Avoidance, minimization, and mitigation measures can be broadly divided into three groups. The first, described in Sections 5.1 Water *Conveyance Facility Design* and 5.2 *Operating Criteria,* concerns the design and operations of the proposed water conveyance facilities. These criteria have elements of both design and implementation that are expected to minimize impacts to both listed fish species and their habitat. The second, described in Section 5.3 *Take Minimization Measures*, concerns guidance, procedures, and performance standards to be applied during design, construction, and maintenance of the water conveyance facilities and the mitigation measures. The third, described in Section 5.4 *Mitigation Measures*, concerns specific measures intended to offset the adverse impacts of the PP and, in many cases, contribute to the conservation of the species. These measures primarily consist of protecting or restoring suitable habitat for the listed species.

5.1 Water Conveyance Facility Design

As described in Section 3.2 *Conveyance Facility Construction*, the water conveyance facility has been designed to minimize[1] effects on state and federally listed species. DWR has conducted many design refinements of the proposed water conveyance facility. The goal of these design optimization exercises was to reduce cost, reduce impacts on surrounding communities, and to reduce environmental effects, particularly to reduce effects on state and federally listed fish species.

5.2 Operating Criteria

Water operations, described in Section 3.3 *Operations and Maintenance of New and Existing Facilities,* have been designed to minimize incidental take of listed species. Aspects of water operations that are specifically intended to minimize incidental take risk include the following.

- Adoption of bypass flows criteria at the north Delta intakes to minimize impingement and entrainment risk for listed fishes by:

[1] In this chapter, the term "minimize" is used in the sense "to reduce something to the smallest possible amount or degree."

  - maintaining fish screen sweeping velocities,
  - minimizing potential increase in upstream transport of productivity in the channels downstream of the intakes,
  - supporting salmonid and pelagic fish movements to regions of suitable habitat,
  - reducing losses to predation downstream of the diversions, and
  - maintaining or improving rearing habitat conditions in the north Delta.

- South Delta export operations are constrained to minimize reverse flows in the Old and Middle Rivers, especially at times of the year when listed fish abundances in these waters are relatively high. This reduces the risks of entrainment and predation in Old River and the south Delta export facilities.

- The Head of Old River Gate operations are timed to minimize risks that listed salmon may enter Old River, thereby reducing the risks of entrainment, impingement, and predation in Old River, the greater south Delta area, and the south Delta export facilities. Note that these operations are tempered by the need to also manage Head of Old River Gate operations consistent with water quality regulations.

- Spring Delta outflow rates are set at a level intended to maintain existing habitat conditions for longfin smelt. Fall outflow rates are designated to continue the requirements of the U.S. Fish and Wildlife Service (2008) biological opinion, which provide preferable habitat conditions for Delta smelt in the fall of above normal and wet years. The operating criteria also provide for minimum flows at Rio Vista and flows throughout the year that meet or exceed those provided by D-1641.

- A real-time operations procedure is adopted that will be used to manage and adjust bypass flows at the north Delta intakes, south Delta export operations, and Head of Old River Gate operations to optimize fish survival probabilities and habitat quality, consistent with overall operations criteria (see Section 3.3.3 Real-Time Operational Decision-Making Process).

- A Monitoring and Research Program (described in Chapter 6 *Monitoring Plan*) is proposed to acquire monitoring data and reduce scientific uncertainty, thereby enabling accurate tracking of operational effects and providing information that can be used to modify operating criteria via a Collaborative Science and Adaptive Management Program (also described in Chapter 6 *Monitoring Plan*). These programs commence prior to operations and yield data that will, in part, be used to guide final design of the NDD and to establish baseline information on conditions prior to NDD operations.

A detailed analysis of the expected effects of these measures on listed species is presented in Chapter 4, *Take Analysis*.

5.3 Take Minimization Measures

Take minimization measures are also referred to in this application and supporting materials as AMMs (avoidance and minimization measures) in order to maintain consistency between the naming of specific measures in the 2081(b) and ESA Section 7 permitting documents (respectively, this application and the biological assessment). There are two types of take minimization measures, general and species-specific. General take minimization measures will be implemented during construction and maintenance of proposed water facilities and performance of mitigation measures. These general take minimization measure apply to all of the listed species and would collectively help to minimize take of these species. The general take minimization measures are summarized in Table 3.2-2. For a detailed description of each of these measures see Appendix 3.F *General Avoidance and Minimization Measures*.

In addition to the general take minimization measures, species-specific take minimization measures are described in this chapter for each of the listed species.

5.3.1 Delta Smelt

All numbered take minimization measures referred to in this section are described in detail in Appendix 3.F *General Avoidance and Minimization Measures*.

5.3.1.1 Construction

5.3.1.1.1 Geotechnical Exploration

DWR will restrict in-water drilling to the in-water work window[2] between the hours of sunrise and sunset. General take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) that will be implemented to avoid or minimize potential turbidity, suspended sediment, and other water quality impacts (e.g., bentonite or contaminant spills) on Delta smelt include: AMM1 *Worker Awareness Training;* AMM2 *Construction Best Management Practices and Monitoring;* AMM3 *Stormwater Pollution Prevention Plan;* AMM4 *Erosion and Sediment Control Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM14 *Hazardous Material Management Plan;* AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material;* and AMM7 *Barge Operations Plan*.

5.3.1.1.2 North Delta Diversions

Construction activities that could potentially affect Delta smelt include the following in-water activities: cofferdam installation and removal, levee clearing and grubbing, riprap placement, dredging, and barge operations. In-water construction or work activities are defined here as activities occurring within the active channel of the river, which would be part of, or immediately adjacent to, the river (e.g., at waterline, in water column, on riverbed, or along river shoreline). All other sediment-disturbing activities associated with construction of the NDDs and associated facilities, including construction of the sedimentation basins, will be isolated from the

[2] Proposed in-water work windows vary within the Delta: June 1 to October 31 at the NDDs, July 1 to November 30 at the CCF, and August 1 to October 31 at both the HOR Gate and the barge landings.

Sacramento River and will use appropriate BMPs and take minimization measures to prevent the discharge of sediment to the river.

5.3.1.1.2.1 Turbidity and Suspended Sediment

Construction activities that disturb the riverbed and banks within the footprints of the north Delta intake facilities may temporarily increase turbidity and suspended sediment levels in the Sacramento River. These activities include cofferdam installation and removal, levee clearing and grading, riprap placement, dredging, and barge operations. These activities will be restricted to the in-water work window[3]. General take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) to avoid or minimize impacts due to increases in turbidity and suspended sediment levels on water quality and direct and indirect affects to listed fish species resulting from sediment-disturbing activities include the following: AMM1 *Worker Awareness Training;* AMM2 *Construction Best Management Practices and Monitoring;* AMM3 *Stormwater Pollution Prevention Plan;* AMM4 *Erosion and Sediment Control Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM14 *Hazardous Material Management Plan;* AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material;* and AMM7 *Barge Operations Plan.*

5.3.1.1.2.2 Contaminants

Construction of the NDDs could result in accidental spills of contaminants, including oil, fuel, hydraulic fluids, concrete, paint, and other construction-related materials, resulting in localized water quality degradation and potential adverse effects on listed fish species. The risk of such effects is highest during in-water construction activities because of the proximity of construction activities to the Sacramento River. Other construction activities that occur in upland areas or are isolated from fish-bearing waters have little or no risk of contaminant effects on aquatic habitat or listed fish species. Implementation of the following general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) is expected to minimize the potential for introduction of contaminants to surface waters and guide rapid and effective response in the case of inadvertent spills of hazardous materials*:* AMM1 *Worker Awareness Training;* AMM2 *Construction Best Management Practices and Monitoring;* AMM3 *Stormwater Pollution Prevention Plan;* AMM4 *Erosion and Sediment Control Plan;* AMM14 *Hazardous Materials Management Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM6 *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; and Barge Operations Plan.*

5.3.1.1.2.3 Underwater Noise

Restriction of pile driving activities in or near open water in the Sacramento River to the in-water work window[3] will minimize the exposure of listed fish species to potentially harmful underwater noise. In addition, DWR will develop and implement an underwater sound control and abatement plan outlining specific measures that can be employed to further minimize potential impacts on Delta smelt, as described in AMM9 *Underwater Sound Control and Abatement Plan* (Appendix 3.F *General Avoidance and Minimization Measures*). If impact pile driving is required, DWR, in coordination with the USFWS, NMFS, and CDFW, will evaluate the feasibility of other protective measures including dewatering, physical devices (e.g., bubble curtains), and operational measures (e.g., restricting pile driving to specific times of the day) to limit the intensity and duration of underwater noise levels when listed fish species may be present. Coordination, implementation, and monitoring of these measures will performed in

accordance with the underwater sound control and abatement plan, which includes hydroacoustic monitoring to determine compliance with established objectives (e.g., distances to cumulative noise thresholds) and corrective actions that will be taken should the thresholds be exceeded.

5.3.1.1.2.4 Fish Stranding

Installation of cofferdams to isolate the construction areas for the NDDs has the potential to strand fish, resulting in direct mortality of fish from dewatering, dredging, and pile driving within the enclosed areas of the channel. To minimize entrapment risk and the number of fish subject to capture and handling during fish rescue and salvage operations, cofferdam construction will be limited to the in-water work window[3]. DWR will prepare and submit a fish rescue and salvage plan as prescribed by AMM8 *Fish Rescue and Salvage Plan* (Appendix 3.F *General Avoidance and Minimization Measures*) to the fish agencies (NMFS, USFWS, CDFW) for review and approval prior to implementation. The plan will include detailed procedures for fish rescue and salvage, including collection, holding, handling, and release, that would apply to all in-water activities with the potential to entrap fish. All fish rescue and salvage operations will be conducted under the guidance of a qualified fish biologist. The biologist, in consultation with a designated agency biologist, will determine the appropriate fish collection and relocation methods based on site-specific conditions and construction methods. Collection methods may include seines, dip nets, and electrofishing if permitted.

5.3.1.1.2.5 Direct Physical Injury

During construction, fish could be injured or killed by direct contact with equipment or materials that enter fish-bearing waters. Potential mechanisms include fish being crushed by falling rock (riprap), impinged by sheetpiles, entrained by dredges, or struck by propellers. Besides adhering to the in-water work window[3], the potential for injury of listed fish species will be minimized by limiting the duration of in-water construction activities to the extent practicable and implementing the following general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*): AMM1 *Worker Awareness Training;* AMM4 *Erosion and Sediment Control Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material;* AMM7 *Barge Operations Plan;* and AMM8 *Fish Rescue and Salvage Plan.*

5.3.1.1.2.6 Loss or Alteration of Habitat

During construction activities, DWR will implement AMM2 *Construction Best Management Practices and Monitoring* (Appendix 3.F *General Avoidance and Minimization Measures*) to protect listed fish species. These BMPs include measures to limit the extent of disturbance of aquatic and riparian habitat during construction, and, following construction, to restore temporarily disturbed areas to pre-construction conditions. All construction and site restoration BMPs will be subject to an approved construction and post-construction monitoring plan to ensure their effectiveness. DWR proposes to offset unavoidable habitat loss at the NDDs through on-site and/or off-site mitigation, including the purchase of conservation credits at an approved conservation bank.

5.3.1.1.3 Barge Landings

5.3.1.1.3.1 Turbidity and Suspended Sediment

Potential turbidity and sediment impacts on listed fish species and aquatic habitat will be minimized by implementing Appendix 3.F *General Avoidance and Minimization Measures,*

AMM7 *Barge Operations Plan*, which includes specific measures to minimize bed scour, bank erosion, loss of submerged and emergent vegetation, and disturbance of benthic communities. Other general take minimization measures that will be implemented to avoid or minimize potential turbidity, suspended sediment, and other water quality impacts include AMM1 *Worker Awareness Training;* AMM2 *Construction Best Management Practices and Monitoring;* AMM3 *Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM 14 *Hazardous Material Management Plan;* and AMM 6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material*.

5.3.1.1.3.2 Contaminants

Construction of the barge landings poses an exposure risk to listed fish species from potential spills of hazardous materials from construction equipment, barges and towing vessels, and other machinery, and from potential mobilization of contaminated sediment. The risk of accidental spills of contaminants and other hazardous materials during construction of the barge landings would be similar to that described for the NDDs due to the proximity of construction activities to the waters of the Delta. However, because the barge landings would be constructed on smaller waterways adjacent to major agricultural islands, these sites are more likely to contain agricultural-related toxins such as copper and organochlorine pesticides. Implementation of the following general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) is expected to minimize the potential for introduction of contaminants into surface waters and guide rapid and effective response in the case of inadvertent spills of hazardous materials: AMM1 *Worker Awareness Training;* AMM2 *Construction Best Management Practices and Monitoring;* AMM3 *Stormwater Pollution Prevention Plan;* AMM4 *Erosion and Sediment Control Plan;* AMM14 *Hazardous Materials Management Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM 6 *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material;* and AMM7 *Barge Operations Plan*.

5.3.1.1.3.3 Underwater Noise

Based on the general timing and abundance of Delta smelt in the east and south Delta, restriction of pile driving activities to the in-water work window[3] will minimize the exposure of listed fish species to pile driving noise. In addition, as described in Section 6.1.1.2 *North Delta Diversions,* DWR will implement Appendix 3.F *General Avoidance and Minimization Measures,* AMM9 *Underwater Sound Control and Abatement Plan* describing specific measures that will be implemented to avoid and minimize the effects of underwater construction noise on listed fish species. These measures include the use of vibratory and other non-impact driving methods as well as other physical and operational measures to limit the intensity and duration of underwater noise levels when listed fish species may be present. Where impact pile driving is required, hydroacoustic monitoring will be performed to determine compliance with established objectives (e.g., distances to cumulative noise thresholds) and corrective actions that will be taken should the thresholds be exceeded.

5.3.1.1.3.4 Fish Stranding

Installation of the perimeter sheet pile wall has the potential to strand fish, resulting in direct injury and mortality of fish that become trapped behind the structures. To minimize this risk, sheet pile installation will be limited to the in-water work window[3]. During periods when listed fish species may be present, DWR will further minimize potential losses of stranded fish by

implementing AMM8 *Fish Rescue and Salvage Plan* (Appendix 3.F *General Avoidance and Minimization Measures*). The plan will be submitted to the fish agencies (NMFS, USFWS, CDFW) for review and approval prior to implementation. The plan will include detailed procedures for fish rescue and salvage, including collection, holding, handling, and release, that would apply to all in-water activities with the potential to entrap fish. All fish rescue and salvage operations will be conducted under the guidance of a qualified fish biologist. The biologist, in consultation with a designated agency biologist, will determine the appropriate fish collection and relocation methods based on site-specific conditions and construction methods. Collection methods may include seines, dip nets, and electrofishing if permitted. DWR proposes to minimize the potential for stranding of listed fish species by conducting all in-water construction activities during the in-water work window[3].

5.3.1.1.3.5 Direct Physical Injury

During construction of barge landings, fish could be injured or killed by direct contact with equipment or materials that are operated or placed in open waters of the adjacent Delta channels. Potential mechanisms include fish being crushed by falling rock (riprap), impinged by sheetpiles or mooring piles, or struck by propellers. In addition to the in-water work window[3], the potential for injury of listed fish species would be minimized by limiting the duration of in-water construction activities to the extent practicable and implementing the following general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*): AMM1 *Worker Awareness Training;* AMM4 *Erosion and Sediment Control Plan;* AMM6 *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material;* AMM7 *Barge Operations Plan; and Fish Rescue and Salvage Plan*.

5.3.1.1.3.6 Loss or Alteration of Habitat

During construction activities, DWR will implement Appendix 3.F *General Avoidance and Minimization Measures*, AMM2 *Construction Best Management Practices and Monitoring*, to protect listed fish species. These BMPs include a number of measures to limit the extent of disturbance of aquatic and riparian habitat during construction, and, following construction, to restore temporarily disturbed areas to pre-construction conditions. All construction and site restoration BMPs will be subject to an approved construction and post-construction monitoring plan to ensure their effectiveness. To further minimize adverse effects to aquatic habitat associated with barge operations, DWR also proposes to implement AMM8 *Barge Operations Plan*, which includes specific measures to minimize bed scour, bank erosion, loss of submerged and emergent vegetation, and disturbance of benthic communities. DWR will offset unavoidable impacts to habitat through on-site and/or off-site mitigation.

5.3.1.1.4 Head of Old River Gate

5.3.1.1.4.1 Turbidity and Suspended Sediment

In-water construction activities would result in disturbance of the channel bed and banks, resulting in temporary increases in turbidity and suspended sediment levels in Old River and potentially the San Joaquin River. These activities include cofferdam construction (sheet pile installation), dredging, riprap placement, and barge operations. All other sediment-disturbing activities will be outside or isolated from the active channel and would not result in the discharge of sediment to the river. Water pumped from the cofferdams will be treated (removing all

sediment) using settling basins or Baker tanks, and returned to the river. Dredging, foundation pile driving, and other construction activities will proceed within the confines of the cofferdams.

In addition to the in-water work window[3], general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures)* that will be implemented to avoid or minimize potential impacts on water quality and listed fish species during construction of the HOR gate include AMM1 *Worker Awareness Training;*AMM2 *Construction Best Management Practices and Monitoring; Stormwater Pollution Prevention Plan;* AMM4 *Erosion and Sediment Control Plan; Spill Prevention, Containment, and Countermeasure Plan;* AMM14 *Hazardous Material Management Plan;* and AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material.*

5.3.1.1.4.2 Contaminants

Construction of the HOR gate poses an exposure risk to listed fish species from potential spills of hazardous materials from construction equipment, barges and towing vessels, and other machinery, and from potential mobilization of contaminated sediment. The risk of accidental spills of contaminants and other potentially hazardous materials would be similar to that described for the NDDs due to the proximity of construction activities to the waters of the Delta. The following general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) will be implemented to minimize the potential for introduction of contaminants into surface waters and guide rapid and effective response in the case of inadvertent spills of hazardous materials: AMM1 *Worker Awareness Training; Construction Best Management Practices and Monitoring;* AMM2 *Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;* AMM14 *Hazardous Materials Management Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM6 *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material;* and AMM7 *Barge Operations Plan*.

5.3.1.1.4.3 Underwater Noise

Based on the general timing and abundance of Delta smelt in the east and south Delta, restriction of pile driving activities to the in-water work window[3] will minimize the exposure of listed fish species to pile driving noise. In addition, as described in Section 6.1.1.2 *North Delta Diversions*, DWR will implement Appendix 3.F *General Avoidance and Minimization Measures,* AMM9 *Underwater Sound Control and Abatement Plan* describing specific measures that will be implemented to avoid and minimize the effects of underwater construction noise on listed fish species. These measures include the use of vibratory and other non-impact driving methods as well as other physical and operational measures to limit the intensity and duration of underwater noise levels when listed fish species may be present. Where impact pile driving is required, hydroacoustic monitoring will be performed to determine compliance with established objectives (e.g., distances to cumulative noise thresholds) and corrective actions that will be taken should the thresholds be exceeded.

5.3.1.1.4.4 Fish Stranding

The use of cofferdams to construct the HOR gate will exclude fish from active construction areas but could also strand fish that are not able to avoid these areas, resulting in direct injury and mortality from dewatering, dredging, and pile driving activities within the enclosed cofferdams. To minimize fish stranding losses, DWR will implement Appendix 3.F *General Avoidance and Minimization Measures,* AMM8 *Fish Rescue and Salvage Plan*. The plan will be submitted to

the fish agencies (NMFS, USFWS, CDFW) for review and approval prior to implementation. The plan will include detailed procedures for fish rescue and salvage, including collection, holding, handling, and release, that would apply to all in-water activities with the potential to entrap fish. All fish rescue and salvage operations will be conducted under the guidance of a qualified fish biologist. The biologist, in consultation with a designated agency biologist, will determine the appropriate fish collection and relocation methods based on site-specific conditions and construction methods. Collection methods may include seines, dip nets, and electrofishing if permitted. DWR proposes to minimize the potential for stranding of listed fish species by conducting all in-water construction activities during the in-water work window[3].

5.3.1.1.4.5 Direct Physical Injury

During construction of the HOR gate, fish could be injured or killed by direct contact with equipment or materials that are operated or placed in open waters of Old River. Potential mechanisms include fish being impinged by sheetpiles, entrained by dredges, or struck by propellers during barge operations. DWR proposes to minimize the potential for injury of Delta smelt and juvenile salmonids by conducting all in-water construction activities during the in-water work window[3]. The potential for injury of listed fish species would also be minimized by implementing general take minimization measures AMM1 *Worker Awareness Training;* AMM4 *Erosion and Sediment Control Plan;* AMM6 *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material;* AMM7 *Barge Operations Plan;* and AMM8 *Fish Rescue and Salvage Plan* (Appendix 3.F *General Avoidance and Minimization Measures*).

5.3.1.1.4.6 Loss or Alteration of Habitat

During construction activities, DWR will implement Appendix 3.F *General Avoidance and Minimization Measures,* AMM2, *Construction Best Management Practices and Monitoring*, to protect listed fish species. These BMPs include a number of measures to limit the extent of disturbance of aquatic and riparian habitat during construction, and, following construction, to restore temporarily disturbed areas to pre-construction conditions. All construction and site restoration BMPs will be subject to an approved construction and post-construction monitoring plan to ensure their effectiveness. DWR will offset unavoidable impacts to habitat through on-site and/or off-site mitigation.

5.3.1.1.5 Clifton Court Forebay

5.3.1.1.5.1 Turbidity and Suspended Sediment

The potential for adverse effects of elevated turbidity and suspended sediment on listed fish species would be minimized by performing all in-water construction activities during the in-water work window[3], and implementing general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) to protect listed fish species from water quality impairment. These measures include AMM1*Worker Awareness Training;* AMM2 *Construction Best Management Practices and Monitoring;* AMM3 *Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM14 *Hazardous Material Management Plan,* and AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material Plan.*

Dredging could cause extensive, long-term effects on turbidity and suspended sediment within CCF. Potential secondary effects include potential increases in chemical and biological oxygen

demand associated with the decomposition of vegetation and organic material in disturbed sediments. In addition to implementing the take minimization measures listed above, DWR proposes to limit the extent of dredging impacts in CCF by restricting daily operations to a dredge operating for 10-hour periods (daylight hours) within a 200-acre cell enclosed by silt curtains. Dredging will be monitored and regulated through the implementation of Appendix 3.F *General Avoidance and Minimization Measures,* AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material Plan*, which includes preparation of a sampling and analysis plan, compliance with NPDES and SWRCB water quality requirements during dredging activities, and compliance with the in-water work window[3].

5.3.1.1.5.2 Contaminants

Dredging and expansion of the CCF and construction of new water conveyance facilities presents an exposure risk to listed fish species from potential spills of hazardous materials from construction equipment and from potential mobilization of contaminated sediment. The risk of accidental spills of oil, fuel, hydraulic fluids, concrete, paint, and other potentially hazardous substances would be similar to that described for the NDDs due to the proximity of construction activities to the waters of the Delta. Implementation of the following general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) will minimize the potential for introduction of contaminants into surface waters and guide rapid and effective response in the case of inadvertent spills of hazardous materials: AMM1*Worker Awareness Training;* AMM2 *Construction Best Management Practices and Monitoring;* AMM3 *Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM14 *Hazardous Material Management Plan,* AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material Plan*, and AMM7 *Barge Operations Plan.*

Prior to dredging and excavation activities, DWR will evaluate the risk of contamination from sediment sources and determine appropriate testing and remediation procedures through the implementation of AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material*.

5.3.1.1.5.3 Underwater Noise

Based on the general timing and abundance of Delta smelt in the east and south Delta, restriction of pile driving activities to the in-water work window[3] will avoid the peak spawning periods of Delta smelt. In addition, as described in Section 6.1.1.2 *North Delta Diversions*, DWR will implement Appendix 3.F *General Avoidance and Minimization Measures,* AMM9 *Underwater Sound Control and Abatement Plan* which requires describing specific measures that will be implemented to avoid and minimize the effects of underwater construction noise on listed fish species. These measures include the use of vibratory and other non-impact driving methods as well as other physical and operational measures to limit the intensity and duration of underwater noise levels when Delta smelt and other listed fish species may be present. Where impact pile driving is required, hydroacoustic monitoring will be performed to determine compliance with established objectives (e.g., distances to cumulative noise thresholds) and corrective actions that will be taken should the thresholds be exceeded.

5.3.1.1.5.4 Fish Stranding

Installation of cofferdams or silt curtains to isolate construction and dredging areas in CCF and the adjacent Old River channel has the potential to strand fish, resulting in direct injury and mortality of fish that become trapped inside the cofferdams or silt curtains. To minimize potential fish stranding losses, DWR will implement Appendix 3.F *General Avoidance and Minimization Measures*, AMM8 *Fish Rescue and Salvage Plan*. This plan will be submitted to the fish agencies (NMFS, USFWS, CDFW) for review and approval prior to implementation. The plan will include detailed procedures for fish rescue and salvage, including collection, holding, handling, and release, that apply to all in-water activities with the potential to entrap fish. All fish rescue and salvage operations will be conducted under the guidance of a qualified fish biologist. The biologist, in consultation with a designated agency biologist, will determine the appropriate fish collection and relocation methods based on site-specific conditions and construction methods. Collection methods may include seines, dip nets, and electrofishing if permitted.

5.3.1.1.5.5 Direct Physical Injury

Fish could be injured or killed by direct contact with equipment or materials during in-water construction activities in CCF and the adjacent Old River channel. Potential mechanisms include fish being crushed by rock (riprap), impinged by sheetpiles, entrained by dredges, or struck by propellers. In addition to the proposed in-water work period, DWR will implement general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) to minimize the potential for impacts on listed fish species, including AMM1 *Worker Awareness Training;* AMM4 *Erosion and Sediment Control Plan;* AMM6 *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material;* AMM7 *Barge Operations Plan;* AMM9 *Underwater Sound Control and Abatement Plan,* and AMM8 *Fish Rescue and Salvage Plan*.

5.3.1.1.5.6 Loss or Alteration of Habitat

During construction activities, DWR will implement Appendix 3.F *General Avoidance and Minimization Measures*, AMM2 *Construction Best Management Practices and Monitoring*, to protect listed fish species. These BMPs include a number of measures to limit the extent of disturbance of aquatic and riparian habitat during construction, and, following construction, to restore temporarily disturbed areas to pre-construction conditions. All construction and site restoration BMPs will be subject to an approved construction and post-construction monitoring plan to ensure their effectiveness. Compensation for unavoidable impacts on aquatic habitat in CCF is not proposed because CCF is not considered suitable habitat for listed fish species.

5.3.1.2 Operations

The primary instrument of minimization and avoidance of impact for listed fish species is compliance with the proposed operational constraints on the PP as detailed in Section 3.3.2 *Operational Criteria*, as further constrained in practice according to real-time operations as described in Section 3.3.3 *Real-Time Operational Decision-Making Process*. Operational constraints detailed in Section 3.3.4 *Operation of South Delta Facilities* and Section 3.3.5 *Water Transfers* also contribute to the avoidance and minimization of incidental take of listed fish species.

Aspects of facility design have also contributed to take avoidance and minimization. The NDDs will be provided with fish screens intended to minimize entrainment, impingement, fatigue and predation risks. Aspects of facility design intended to achieve these goals are detailed in Section 3.2.2.1 *Intake Design* and Section 3.2.2.2 *Fish Screen Design*. Moreover, a variety of preconstruction studies are proposed to aid in refinement of the fish screen design; see Chapter 6 *Monitoring Plan* for a listing and description of these studies.

In addition, Reasonable and Prudent Measures required under the existing USFWS (2008) biological opinion will continue to be implemented under the PP and serve as minimization measures for the protection of Delta smelt (see Table 1-2 *SWP Facilities and Activities Included and Not Included in the Proposed Project* for a full listing of the applicable USFWS actions). The existing commitments for operation of the NBA diversion stemming from the California Department of Fish and Game (2009) incidental take permit for longfin smelt, described in Section 3.3.2.6 *Operational Criteria for the North Bay Aqueduct Intake*, would also continue to be implemented under the PP and would serve to minimize the potential for Delta smelt entrainment and impingement.

Similarly, the Roaring River Distribution System (RRDS) water intake, consisting of eight 60-inch-diameter culverts, is equipped with fish screens (3/32-inch opening, or 2.4 mm) operated to maintain a screen approach velocity of 0.2 ft/s for Delta smelt protection, eliminating the risk of entrainment and minimizing the risk of impingement. Nothing in the PP would reduce this level of protection.

Herbicide treatment of aquatic weeds at CCF in July/August would avoid potential effects to Delta smelt because treatment would occur at a time when none of the Delta smelt life stages are expected to be present in CCF.

5.3.1.2.1 Effects of Sediment Removal at the North Delta Diversions

As described in Section 3.2.10.6 *Dispose Spoils*, the NDD is expected to divert a portion of the Sacramento River's sediment load, which could result in higher water clarity downstream because less sediment may over time allow greater erosion and less wind- and velocity-driven resuspension of sediment into the water column. To the maximum extent practicable, the first and preferred disposition of this material will be to reintroduce it to the water column in order to maintain Delta turbidity as a component of Delta smelt habitat. DWR will collaborate with USFWS and CDFW to develop and implement a sediment reintroduction plan that provides the desired beneficial habitat effects of maintained turbidity while addressing related permitting concerns (the proposed sediment reintroduction is expected to require permits from the Central Valley Regional Water Quality Control Board and USACE). CDFW, USFWS and NMFS will have approval authority for this plan and for monitoring measures, to be specified in the plan, to assess its effectiveness. Considering only the Sacramento River load at Freeport, it was estimated that a mean of 11% (range: 7–16%) of sediment load would be removed by the NDD. If this sediment, some of which will be collected in the sedimentation basins (described in Section 3.2.2 *North Delta Diversions*) is not returned to the system, it is possible that water transparency in the Delta will increase over time due to project operations. Note that the analysis did not attempt to provide a quantitative estimate for sediment removal by the south Delta export facilities under the NAA or PA; based on the estimates by Wright and Schoellhamer (2005), sediment removal

by the south Delta export facilities in 1999-2002 averaged around 2% of the sediment entering the Delta at Freeport, i.e., an order of magnitude less than estimated to be removed at the NDD, so the net sediment removal under the PA (NDD exports plus less south Delta exports than NAA) would be expected to be appreciably greater than sediment removal under NAA. As described in Section 3.2.10.6, *Dispose Spoils*, in Chapter 3, DWR will collaborate with USFWS and CDFW to develop and implement a sediment reintroduction plan that provides the desired beneficial habitat effects of maintained turbidity while addressing related permitting concerns (the proposed sediment reintroduction is expected to require permits from the Water Control Board and USACE). This would minimize the effects of sediment removal by the NDD.

5.3.1.2.2 Effects of Spring Outflow

Given recent evidence for the potential positive effects of spring outflow on Delta Smelt early life stages (IEP MAST Team 2015), proposed spring outflow criteria for Longfin Smelt (see Section 4.2.7.2.2 *Effect of Take Minimization Measures* for that species and Section 5.3.2 *Longfin Smelt*) could also potentially benefit Delta Smelt, relative to not having these spring outflow criteria in place. Such benefits could occur for example by reducing south Delta exports (to increase outflow) and therefore reducing south Delta entrainment directly, or by reducing north or south Delta exports with the result that Delta Smelt larvae may be distributed farther downstream (as reflected in lower X2, shown to be an important driver of entrainment in the percentage entrainment loss regression; see Tables 4.D-5 and 4.D-6 in Appendix 4.D *Comparison of Key Hydrological Variables for Proposed Project with Longfin Smelt Spring Outflow Criteria to No Action Alternative and Proposed Project Scenarios*). However, as previously noted, the risk for entrainment would in any case be carefully managed in real time that will occur under both the NAA and PP, incorporating the latest information gained from the results of coordinated monitoring and research under the Collaborative Science and Adaptive Management Program (Chapter 6 *Monitoring Plan*) about fish distribution and other factors that affect entrainment risk.

5.3.1.3 Maintenance

5.3.1.3.1 North Delta Diversions

Maintenance activities that could affect listed fish species include suction dredging or mechanical excavation of accumulated sediment around the intake structures; periodic removal of debris and biofouling organisms (e.g., algae, clams, mussels) from the log boom, fish screen panels, cleaning system, and other structural and mechanical elements exposed to the river; and levee maintenance activities, including repairs (e.g., RSP replacement) and vegetation control on the waterside levee slope. It is anticipated that in-river dredging will be required every 2-3 years on average. A formal dredging plan describing specific maintenance dredging activities will be developed prior to dredging activities. Guidelines related to dredging activities and disposal and reuse of spoils, including compliance with the in-water work window[3] and turbidity standards, are described in Appendix 3.F *General Avoidance and Minimization Measures*, AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material*. RSP replacement may necessitate access and work either from the levee crest (e.g., using an excavator) or from the water (e.g., using a barge and crane).

All in-water maintenance activities will be conducted within the in-water work window[3], in accordance with general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) including AMM1 *Worker Awareness Training;* AMM2 *Construction Best Management Practices and Monitoring;* AMM3 *Stormwater Pollution Prevention Plan;* AMM4 *Erosion and Sediment Control Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM14 *Hazardous Material Management Plan;* AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material;* and AMM7 *Barge Operations Plan*.

5.3.1.3.2 Barge Landings

Maintenance activities at the barge landings include regular visual inspections, routine maintenance, and periodic repairs of the docking, loading, and unloading facilities. Maintenance dredging from barges may be required to maintain sufficient water depths for access, maneuvering, and mooring of barges over the course of barge landing operations. Maintenance activities also include levee repairs (e.g., riprap replacement) and vegetation control measures on the waterside slope of the levee. RSP replacement may necessitate access and work either from the levee crest (e.g., using an excavator) or from the water (e.g., using a barge and crane). All in-water maintenance activities will be conducted within the in-water work window[3], in accordance with general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) including AMM1 *Worker Awareness Training;* AMM2 *Construction Best Management Practices and Monitoring;* AMM3 *Stormwater Pollution Prevention Plan;* AMM4 *Erosion and Sediment Control Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM14 *Hazardous Material Management Plan;* AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material;* and AMM7 *Barge Operations Plan*.

5.3.1.3.3 Head of Old River Gate

Maintenance of the Head of Old River (HOR) gate, including fishway, boat lock, and navigation structures, includes require regular visual inspections and adjustments of the facilities to maintain compliance with engineering and performance standards, and periodic repairs to prevent mechanical, structural, and electrical failures. Routine maintenance includes regular servicing and repair of motors, compressors, and control systems, and periodic repairs to the mechanical and structural elements of the gate, fishway, and boat lock. Maintenance activities include periodic dredging to remove accumulated sediment from around the gate structure, dewatering of the gate facilities for inspection and maintenance, and replacement of riprap to repair eroded or damaged portions of the waterside levee slope. All in-water maintenance will be conducted within the in-water work window[3], in accordance with general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) including AMM1 *Worker Awareness Training;* AMM2 *Construction Best Management Practices and Monitoring;* AMM3 *Stormwater Pollution Prevention Plan;* AMM4 *Erosion and Sediment Control Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM14 *Hazardous Material Management Plan;* AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material;* and AMM7 *Barge Operations Plan*.

Maintenance dredging may be needed every 3 to 5 years to remove sediment that may potentially interfere with gate operations, navigation, and fish passage. Dredging will be conducted with a sealed clamshell dredge operated from a barge or from the top of the levee. A floating turbidity control curtain will be used to limit the dispersion of suspended sediment during dredging operations. Dredging will comply with the in-water work window[3] and turbidity standards, and will be performed as described in Appendix 3.F *General Avoidance and Minimization Measures*, AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material*.

Each gate bay will be inspected annually at the end of the wet season for sediment accumulation. Each miter or radial gate bay will include stop log guides and pockets for stop log posts to facilitate the dewatering of individual bays for inspection and maintenance. Major maintenance could require a temporary cofferdam upstream and downstream for dewatering. When listed fish species may be present during dewatering operations, DWR will minimize potential stranding losses by implementing AMM8 *Fish Rescue and Salvage Plan*.

5.3.1.3.4 Clifton Court Forebay

Maintenance of the water conveyance facilities and other infrastructure at CCF (including Clifton Court Pumping Plant [CCPP], divider and perimeter embankments, outlet canals and siphons, South CCF [SCCF] intake structure, and North CCF [NCCF] emergency spillway) will include regular visual inspections and adjustments of the facilities to maintain compliance with engineering and performance standards, and periodic repairs to prevent mechanical, structural, and electrical failures. Emergency maintenance is also anticipated. Maintenance requirements potentially affecting listed fish species in CCF and Old River include dredging or mechanical excavation of accumulated sediment around the pumping, intake, and outlet facilities, and embankment maintenance activities, including repairs (e.g., RSP replacement) and vegetation control on the divider and perimeter embankments. With upstream sediment removal at the north Delta sedimentation facilities and expansion of storage capacity at CCF, the need for additional dredging of NCCF and SCCF over the first 50 years following construction is expected to be minimal. All in-water maintenance activities will be conducted within the in-water work window[3], in accordance with general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) including AMM1 *Worker Awareness Training;* AMM2 *Construction Best Management Practices and Monitoring;* AMM3 *Stormwater Pollution Prevention Plan;* AMM4 *Erosion and Sediment Control Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM14 *Hazardous Material Management Plan;* AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material;* and AMM7 *Barge Operations Plan*.

5.3.2 Longfin Smelt

All numbered take minimization measures referred to in this section are described in detail in Appendix 3.F *General Avoidance and Minimization Measures*.

5.3.2.1 Construction

5.3.2.1.1 Geotechnical Exploration

DWR will restrict in-water drilling to the in-water work window[3] between the hours of sunrise and sunset. General take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) that will be implemented to avoid or minimize potential turbidity, suspended sediment, and other water quality impacts (e.g., bentonite or contaminant spills) on longfin smelt include: AMM1 *Worker Awareness Training;* AMM2 *Construction Best Management Practices and Monitoring;* AMM3 *Stormwater Pollution Prevention Plan;* AMM4 *Erosion and Sediment Control Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM14 *Hazardous Material Management Plan;* AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material;* and AMM7 *Barge Operations Plan.*

5.3.2.1.2 North Delta Diversions

Construction activities that could potentially affect longfin smelt include the following in-water activities: cofferdam installation and removal, levee clearing and grubbing, riprap placement, dredging, and barge operations. In-water construction or work activities are defined here as activities occurring within the active channel of the river, which would be part of, or immediately adjacent to, the river (e.g., at waterline, in water column, on riverbed, or along river shoreline). All other sediment-disturbing activities associated with construction of the NDDs and associated facilities, including construction of the sedimentation basins, will be isolated from the Sacramento River and will use appropriate BMPs and take minimization measures to prevent the discharge of sediment to the river.

5.3.2.1.2.1 Turbidity and Suspended Sediment

Construction activities that disturb the riverbed and banks within the footprints of the north Delta intake facilities may temporarily increase turbidity and suspended sediment levels in the Sacramento River. These activities include cofferdam installation and removal, levee clearing and grading, riprap placement, dredging, and barge operations. These activities will be restricted to the in-water work window[3]. General take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) to avoid or minimize impacts due to increases in turbidity and suspended sediment levels on water quality and direct and indirect affects to listed fish species resulting from sediment-disturbing activities include the following: AMM1 *Worker Awareness Training;* AMM2 *Construction Best Management Practices and Monitoring;* AMM3 *Stormwater Pollution Prevention Plan;* AMM4 *Erosion and Sediment Control Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM14 *Hazardous Material Management Plan;* AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material;* and AMM7 *Barge Operations Plan.*

[3] Proposed in-water work windows vary within the Delta: June 1 to October 31 at the NDDs, July 1 to November 30 at the CCF, and August 1 to October 31 at both the HOR Gate and the barge landings.

5.3.2.1.2.2 Contaminants

Construction of the NDDs could result in accidental spills of contaminants, including oil, fuel, hydraulic fluids, concrete, paint, and other construction-related materials, resulting in localized water quality degradation and potential adverse effects on listed fish species. The risk of such effects is highest during in-water construction activities because of the proximity of construction activities to the Sacramento River. Other construction activities that occur in upland areas or are isolated from fish-bearing waters have little or no risk of contaminant effects on aquatic habitat or listed fish species. Implementation of the following general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) is expected to minimize the potential for introduction of contaminants to surface waters and guide rapid and effective response in the case of inadvertent spills of hazardous materials*:* AMM1 *Worker Awareness Training;* AMM2 *Construction Best Management Practices and Monitoring;* AMM3 *Stormwater Pollution Prevention Plan;* AMM4 *Erosion and Sediment Control Plan;* AMM14 *Hazardous Materials Management Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM6 *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; and Barge Operations Plan.*

5.3.2.1.2.3 Underwater Noise

Restriction of pile driving activities in or near open water in the Sacramento River to the in-water work window[3] will minimize the exposure of listed fish species to potentially harmful underwater noise. In addition, DWR will develop and implement an underwater sound control and abatement plan outlining specific measures that can be employed to further minimize potential impacts on longfin smelt, as described in AMM9 *Underwater Sound Control and Abatement Plan* (Appendix 3.F *General Avoidance and Minimization Measures*). If impact pile driving is required, DWR, in coordination with the USFWS, NMFS, and CDFW, will evaluate the feasibility of other protective measures including dewatering, physical devices (e.g., bubble curtains), and operational measures (e.g., restricting pile driving to specific times of the day) to limit the intensity and duration of underwater noise levels when listed fish species may be present. Coordination, implementation, and monitoring of these measures will performed in accordance with the underwater sound control and abatement plan, which includes hydroacoustic monitoring to determine compliance with established objectives (e.g., distances to cumulative noise thresholds) and corrective actions that will be taken should the thresholds be exceeded.

5.3.2.1.2.4 Fish Stranding

Installation of cofferdams to isolate the construction areas for the NDDs has the potential to strand fish, resulting in direct mortality of fish from dewatering, dredging, and pile driving within the enclosed areas of the channel. To minimize entrapment risk and the number of fish subject to capture and handling during fish rescue and salvage operations, cofferdam construction will be limited to the in-water work window[3]. DWR will prepare and submit a fish rescue and salvage plan as prescribed by AMM8 *Fish Rescue and Salvage Plan* (Appendix 3.F *General Avoidance and Minimization Measures*) to the fish agencies (NMFS, USFWS, CDFW) for review and approval prior to implementation. The plan will include detailed procedures for fish rescue and salvage, including collection, holding, handling, and release, that would apply to all in-water activities with the potential to entrap fish. All fish rescue and salvage operations will be conducted under the guidance of a qualified fish biologist. The biologist, in consultation with a designated agency biologist, will determine the appropriate fish collection and relocation

methods based on site-specific conditions and construction methods. Collection methods may include seines, dip nets, and electrofishing if permitted.

5.3.2.1.2.5 Direct Physical Injury

During construction, fish could be injured or killed by direct contact with equipment or materials that enter fish-bearing waters. Potential mechanisms include fish being crushed by falling rock (riprap), impinged by sheetpiles, entrained by dredges, or struck by propellers. Besides adhering to the in-water work window[3], the potential for injury of listed fish species will be minimized by limiting the duration of in-water construction activities to the extent practicable and implementing the following general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*): AMM1 *Worker Awareness Training;* AMM4 *Erosion and Sediment Control Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material;* AMM7 *Barge Operations Plan;* and AMM8 *Fish Rescue and Salvage Plan*.

5.3.2.1.2.6 Loss or Alteration of Habitat

During construction activities, DWR will implement AMM2 *Construction Best Management Practices and Monitoring* (Appendix 3.F *General Avoidance and Minimization Measures*) to protect listed fish species. These BMPs include measures to limit the extent of disturbance of aquatic and riparian habitat during construction, and, following construction, to restore temporarily disturbed areas to pre-construction conditions. All construction and site restoration BMPs will be subject to an approved construction and post-construction monitoring plan to ensure their effectiveness. DWR proposes to offset unavoidable habitat loss at the NDDs through on-site and/or off-site mitigation, including the purchase of conservation credits at an approved conservation bank.

5.3.2.1.3 Barge Landings

5.3.2.1.3.1 Turbidity and Suspended Sediment

Potential turbidity and sediment impacts on listed fish species and aquatic habitat will be minimized by implementing Appendix 3.F *General Avoidance and Minimization Measures,* AMM7 *Barge Operations Plan,* which includes specific measures to minimize bed scour, bank erosion, loss of submerged and emergent vegetation, and disturbance of benthic communities. Other general take minimization measures that will be implemented to avoid or minimize potential turbidity, suspended sediment, and other water quality impacts include AMM1 *Worker Awareness Training;* AMM2 *Construction Best Management Practices and Monitoring;* AMM3 *Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM 14 *Hazardous Material Management Plan;* and AMM 6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material*.

5.3.2.1.3.2 Contaminants

Construction of the barge landings poses an exposure risk to listed fish species from potential spills of hazardous materials from construction equipment, barges and towing vessels, and other machinery, and from potential mobilization of contaminated sediment. The risk of accidental spills of contaminants and other hazardous materials during construction of the barge landings would be similar to that described for the NDDs due to the proximity of construction activities to the waters of the Delta. However, because the barge landings would be constructed on smaller

waterways adjacent to major agricultural islands, these sites are more likely to contain agricultural-related toxins such as copper and organochlorine pesticides. Implementation of the following general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) is expected to minimize the potential for introduction of contaminants into surface waters and guide rapid and effective response in the case of inadvertent spills of hazardous materials: AMM1 *Worker Awareness Training;* AMM2 *Construction Best Management Practices and Monitoring;* AMM3 *Stormwater Pollution Prevention Plan;* AMM4 *Erosion and Sediment Control Plan;* AMM14 *Hazardous Materials Management Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM 6 *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material;* and AMM7 *Barge Operations Plan.*

5.3.2.1.3.3 Underwater Noise

Based on the general timing and abundance of longfin smelt in the east and south Delta, restriction of pile driving activities to the in-water work window[3] will minimize the exposure of listed fish species to pile driving noise. In addition, as described in Section 6.1.1.2 *North Delta Diversions*, DWR will implement Appendix 3.F *General Avoidance and Minimization Measures*, AMM9 *Underwater Sound Control and Abatement Plan* describing specific measures that will be implemented to avoid and minimize the effects of underwater construction noise on listed fish species. These measures include the use of vibratory and other non-impact driving methods as well as other physical and operational measures to limit the intensity and duration of underwater noise levels when listed fish species may be present. Where impact pile driving is required, hydroacoustic monitoring will be performed to determine compliance with established objectives (e.g., distances to cumulative noise thresholds) and corrective actions that will be taken should the thresholds be exceeded.

5.3.2.1.3.4 Fish Stranding

Installation of the perimeter sheet pile wall has the potential to strand fish, resulting in direct injury and mortality of fish that become trapped behind the structures. To minimize this risk, sheet pile installation will be limited to the in-water work window[3]. During periods when listed fish species may be present, DWR will further minimize potential losses of stranded fish by implementing AMM8 *Fish Rescue and Salvage Plan* (Appendix 3.F *General Avoidance and Minimization Measures*). The plan will be submitted to the fish agencies (NMFS, USFWS, CDFW) for review and approval prior to implementation. The plan will include detailed procedures for fish rescue and salvage, including collection, holding, handling, and release, that would apply to all in-water activities with the potential to entrap fish. All fish rescue and salvage operations will be conducted under the guidance of a qualified fish biologist. The biologist, in consultation with a designated agency biologist, will determine the appropriate fish collection and relocation methods based on site-specific conditions and construction methods. Collection methods may include seines, dip nets, and electrofishing if permitted. DWR proposes to minimize the potential for stranding of listed fish species by conducting all in-water construction activities during the in-water work window[3].

5.3.2.1.3.5 Direct Physical Injury

During construction of barge landings, fish could be injured or killed by direct contact with equipment or materials that are operated or placed in open waters of the adjacent Delta channels. Potential mechanisms include fish being crushed by falling rock (riprap), impinged by sheetpiles or mooring piles, or struck by propellers. In addition to the in-water work window[3], the potential

for injury of listed fish species would be minimized by limiting the duration of in-water construction activities to the extent practicable and implementing the following general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*): AMM1 *Worker Awareness Training;* AMM4 *Erosion and Sediment Control Plan;* AMM6 *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material;* AMM7 *Barge Operations Plan; and Fish Rescue and Salvage Plan*.

5.3.2.1.3.6 Loss or Alteration of Habitat

During construction activities, DWR will implement Appendix 3.F *General Avoidance and Minimization Measures*, AMM2 *Construction Best Management Practices and Monitoring*, to protect listed fish species. These BMPs include a number of measures to limit the extent of disturbance of aquatic and riparian habitat during construction, and, following construction, to restore temporarily disturbed areas to pre-construction conditions. All construction and site restoration BMPs will be subject to an approved construction and post-construction monitoring plan to ensure their effectiveness. To further minimize adverse effects to aquatic habitat associated with barge operations, DWR also proposes to implement AMM8 *Barge Operations Plan*, which includes specific measures to minimize bed scour, bank erosion, loss of submerged and emergent vegetation, and disturbance of benthic communities. DWR will offset unavoidable impacts to habitat through on-site and/or off-site mitigation.

5.3.2.1.4 Head of Old River Gate

5.3.2.1.4.1 Turbidity and Suspended Sediment

In-water construction activities would result in disturbance of the channel bed and banks, resulting in temporary increases in turbidity and suspended sediment levels in Old River and potentially the San Joaquin River. These activities include cofferdam construction (sheet pile installation), dredging, riprap placement, and barge operations. All other sediment-disturbing activities will be outside or isolated from the active channel and would not result in the discharge of sediment to the river. Water pumped from the cofferdams will be treated (removing all sediment) using settling basins or Baker tanks, and returned to the river. Dredging, foundation pile driving, and other construction activities will proceed within the confines of the cofferdams.

In addition to the in-water work window[3], general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures)* that will be implemented to avoid or minimize potential impacts on water quality and listed fish species during construction of the HOR gate include AMM1 *Worker Awareness Training;*AMM2 *Construction Best Management Practices and Monitoring; Stormwater Pollution Prevention Plan;* AMM4 *Erosion and Sediment Control Plan; Spill Prevention, Containment, and Countermeasure Plan;* AMM14 *Hazardous Material Management Plan;* and AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material.*

5.3.2.1.4.2 Contaminants

Construction of the HOR gate poses an exposure risk to listed fish species from potential spills of hazardous materials from construction equipment, barges and towing vessels, and other machinery, and from potential mobilization of contaminated sediment. The risk of accidental spills of contaminants and other potentially hazardous materials would be similar to that described for the NDDs due to the proximity of construction activities to the waters of the Delta.

The following general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) will be implemented to minimize the potential for introduction of contaminants into surface waters and guide rapid and effective response in the case of inadvertent spills of hazardous materials: AMM1 *Worker Awareness Training; Construction Best Management Practices and Monitoring;* AMM2 *Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;* AMM14 *Hazardous Materials Management Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM6 *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material;* and AMM7 *Barge Operations Plan.*

5.3.2.1.4.3 Underwater Noise

Based on the general timing and abundance of longfin smelt in the east and south Delta, restriction of pile driving activities to the in-water work window[3] will minimize the exposure of listed fish species to pile driving noise. In addition, as described in Section 6.1.1.2 *North Delta Diversions*, DWR will implement Appendix 3.F *General Avoidance and Minimization Measures*, AMM9 *Underwater Sound Control and Abatement Plan* describing specific measures that will be implemented to avoid and minimize the effects of underwater construction noise on listed fish species. These measures include the use of vibratory and other non-impact driving methods as well as other physical and operational measures to limit the intensity and duration of underwater noise levels when listed fish species may be present. Where impact pile driving is required, hydroacoustic monitoring will be performed to determine compliance with established objectives (e.g., distances to cumulative noise thresholds) and corrective actions that will be taken should the thresholds be exceeded.

5.3.2.1.4.4 Fish Stranding

The use of cofferdams to construct the HOR gate will exclude fish from active construction areas but could also strand fish that are not able to avoid these areas, resulting in direct injury and mortality from dewatering, dredging, and pile driving activities within the enclosed cofferdams. To minimize fish stranding losses, DWR will implement Appendix 3.F *General Avoidance and Minimization Measures*, AMM8 *Fish Rescue and Salvage Plan*. The plan will be submitted to the fish agencies (NMFS, USFWS, CDFW) for review and approval prior to implementation. The plan will include detailed procedures for fish rescue and salvage, including collection, holding, handling, and release, that would apply to all in-water activities with the potential to entrap fish. All fish rescue and salvage operations will be conducted under the guidance of a qualified fish biologist. The biologist, in consultation with a designated agency biologist, will determine the appropriate fish collection and relocation methods based on site-specific conditions and construction methods. Collection methods may include seines, dip nets, and electrofishing if permitted. DWR proposes to minimize the potential for stranding of listed fish species by conducting all in-water construction activities during the in-water work window[3].

5.3.2.1.4.5 Direct Physical Injury

During construction of the HOR gate, fish could be injured or killed by direct contact with equipment or materials that are operated or placed in open waters of Old River. Potential mechanisms include fish being impinged by sheetpiles, entrained by dredges, or struck by propellers during barge operations. DWR proposes to minimize the potential for injury of longfin smelt by conducting all in-water construction activities during the in-water work window[3]. The potential for injury of listed fish species would also be minimized by implementing general take minimization measures AMM1 *Worker Awareness Training;* AMM4 *Erosion and Sediment*

Control Plan; AMM6 *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material;* AMM7 *Barge Operations Plan;* and AMM8 *Fish Rescue and Salvage Plan* (Appendix 3.F *General Avoidance and Minimization Measures*).

5.3.2.1.4.6 Loss or Alteration of Habitat

During construction activities, DWR will implement Appendix 3.F *General Avoidance and Minimization Measures,* AMM2, *Construction Best Management Practices and Monitoring*, to protect listed fish species. These BMPs include a number of measures to limit the extent of disturbance of aquatic and riparian habitat during construction, and, following construction, to restore temporarily disturbed areas to pre-construction conditions. All construction and site restoration BMPs will be subject to an approved construction and post-construction monitoring plan to ensure their effectiveness. DWR will offset unavoidable impacts to habitat through on-site and/or off-site mitigation.

5.3.2.1.5 Clifton Court Forebay

5.3.2.1.5.1 Turbidity and Suspended Sediment

The potential for adverse effects of elevated turbidity and suspended sediment on listed fish species would be minimized by performing all in-water construction activities during the in-water work window[3], and implementing general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) to protect listed fish species from water quality impairment. These measures include AMM1*Worker Awareness Training;* AMM2 *Construction Best Management Practices and Monitoring;* AMM3 *Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM14 *Hazardous Material Management Plan,* and AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material Plan*.

Dredging could cause extensive, long-term effects on turbidity and suspended sediment within CCF. Potential secondary effects include potential increases in chemical and biological oxygen demand associated with the decomposition of vegetation and organic material in disturbed sediments. In addition to implementing the take minimization measures listed above, DWR proposes to limit the extent of dredging impacts in CCF by restricting daily operations to a dredge operating for 10-hour periods (daylight hours) within a 200-acre cell enclosed by silt curtains. Dredging will be monitored and regulated through the implementation of Appendix 3.F *General Avoidance and Minimization Measures,* AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material Plan*, which includes preparation of a sampling and analysis plan, compliance with NPDES and SWRCB water quality requirements during dredging activities, and compliance with the in-water work window[3].

5.3.2.1.5.2 Contaminants

Dredging and expansion of the CCF and construction of new water conveyance facilities presents an exposure risk to listed fish species from potential spills of hazardous materials from construction equipment and from potential mobilization of contaminated sediment. The risk of accidental spills of oil, fuel, hydraulic fluids, concrete, paint, and other potentially hazardous substances would be similar to that described for the NDDs due to the proximity of construction activities to the waters of the Delta. Implementation of the following general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) will minimize the

potential for introduction of contaminants into surface waters and guide rapid and effective response in the case of inadvertent spills of hazardous materials: AMM1*Worker Awareness Training;* AMM2 *Construction Best Management Practices and Monitoring;* AMM3 *Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM14 *Hazardous Material Management Plan,* AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material Plan,* and AMM7 *Barge Operations Plan.*

Prior to dredging and excavation activities, DWR will evaluate the risk of contamination from sediment sources and determine appropriate testing and remediation procedures through the implementation of AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material*.

5.3.2.1.5.3 Underwater Noise

Based on the general timing and abundance of longfin smelt in the east and south Delta, restriction of pile driving activities to the in-water work window[3] will avoid the peak spawning periods of longfin smelt. In addition, as described in Section 6.1.1.2 *North Delta Diversions*, DWR will implement Appendix 3.F *General Avoidance and Minimization Measures,* AMM9 *Underwater Sound Control and Abatement Plan* which requires describing specific measures that will be implemented to avoid and minimize the effects of underwater construction noise on listed fish species. These measures include the use of vibratory and other non-impact driving methods as well as other physical and operational measures to limit the intensity and duration of underwater noise levels when longfin smelt and other listed fish species may be present. Where impact pile driving is required, hydroacoustic monitoring will be performed to determine compliance with established objectives (e.g., distances to cumulative noise thresholds) and corrective actions that will be taken should the thresholds be exceeded.

5.3.2.1.5.4 Fish Stranding

Installation of cofferdams or silt curtains to isolate construction and dredging areas in CCF and the adjacent Old River channel has the potential to strand fish, resulting in direct injury and mortality of fish that become trapped inside the cofferdams or silt curtains. To minimize potential fish stranding losses, DWR will implement Appendix 3.F *General Avoidance and Minimization Measures*, AMM8 *Fish Rescue and Salvage Plan*. This plan will be submitted to the fish agencies (NMFS, USFWS, CDFW) for review and approval prior to implementation. The plan will include detailed procedures for fish rescue and salvage, including collection, holding, handling, and release, that apply to all in-water activities with the potential to entrap fish. All fish rescue and salvage operations will be conducted under the guidance of a qualified fish biologist. The biologist, in consultation with a designated agency biologist, will determine the appropriate fish collection and relocation methods based on site-specific conditions and construction methods. Collection methods may include seines, dip nets, and electrofishing if permitted.

5.3.2.1.5.5 Direct Physical Injury

Fish could be injured or killed by direct contact with equipment or materials during in-water construction activities in CCF and the adjacent Old River channel. Potential mechanisms include fish being crushed by rock (riprap), impinged by sheetpiles, entrained by dredges, or struck by propellers. In addition to the proposed in-water work period, DWR will implement general take

minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) to minimize the potential for impacts on listed fish species, including AMM1 *Worker Awareness Training;* AMM4 *Erosion and Sediment Control Plan;* AMM6 *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material;* AMM7 *Barge Operations Plan;* AMM9 *Underwater Sound Control and Abatement Plan,* and AMM8 *Fish Rescue and Salvage Plan*.

5.3.2.1.5.6 Loss or Alteration of Habitat

During construction activities, DWR will implement Appendix 3.F *General Avoidance and Minimization Measures*, AMM2 *Construction Best Management Practices and Monitoring*, to protect listed fish species. These BMPs include a number of measures to limit the extent of disturbance of aquatic and riparian habitat during construction, and, following construction, to restore temporarily disturbed areas to pre-construction conditions. All construction and site restoration BMPs will be subject to an approved construction and post-construction monitoring plan to ensure their effectiveness. Compensation for unavoidable impacts on aquatic habitat in CCF is not proposed because CCF is not considered suitable habitat for listed fish species.

5.3.2.2 Maintenance

Note that this Application does not request take authorization for maintenance activities; the following information is provided for context, and to support the jeopardy analysis.

5.3.2.2.1 North Delta Diversions

Maintenance activities that could affect listed fish species include suction dredging or mechanical excavation of accumulated sediment around the intake structures; periodic removal of debris and biofouling organisms (e.g., algae, clams, mussels) from the log boom, fish screen panels, cleaning system, and other structural and mechanical elements exposed to the river; and levee maintenance activities, including repairs (e.g., RSP replacement) and vegetation control on the waterside levee slope. It is anticipated that in-river dredging will be required every 2-3 years on average. A formal dredging plan describing specific maintenance dredging activities will be developed prior to dredging activities. Guidelines related to dredging activities and disposal and reuse of spoils, including compliance with the in-water work window[3] and turbidity standards, are described in Appendix 3.F *General Avoidance and Minimization Measures*, AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material*. RSP replacement may necessitate access and work either from the levee crest (e.g., using an excavator) or from the water (e.g., using a barge and crane).

All in-water maintenance activities will be conducted within the in-water work window[3], in accordance with general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) including AMM1 *Worker Awareness Training;* AMM2 *Construction Best Management Practices and Monitoring;* AMM3 *Stormwater Pollution Prevention Plan;* AMM4 *Erosion and Sediment Control Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM14 *Hazardous Material Management Plan;* AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material;* and AMM7 *Barge Operations Plan*.

5.3.2.2.2 Barge Landings

Maintenance activities at the barge landings include regular visual inspections, routine maintenance, and periodic repairs of the docking, loading, and unloading facilities. Maintenance dredging from barges may be required to maintain sufficient water depths for access, maneuvering, and mooring of barges over the course of barge landing operations. Maintenance activities also include levee repairs (e.g., riprap replacement) and vegetation control measures on the waterside slope of the levee. RSP replacement may necessitate access and work either from the levee crest (e.g., using an excavator) or from the water (e.g., using a barge and crane). All in-water maintenance activities will be conducted within the in-water work window[3], in accordance with general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) including AMM1 *Worker Awareness Training;* AMM2 *Construction Best Management Practices and Monitoring;* AMM3 *Stormwater Pollution Prevention Plan;* AMM4 *Erosion and Sediment Control Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM14 *Hazardous Material Management Plan;* AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material;* and AMM7 *Barge Operations Plan*.

5.3.2.2.3 Head of Old River Gate

Maintenance of the Head of Old River (HOR) gate, including fishway, boat lock, and navigation structures, includes require regular visual inspections and adjustments of the facilities to maintain compliance with engineering and performance standards, and periodic repairs to prevent mechanical, structural, and electrical failures. Routine maintenance includes regular servicing and repair of motors, compressors, and control systems, and periodic repairs to the mechanical and structural elements of the gate, fishway, and boat lock. Maintenance activities include periodic dredging to remove accumulated sediment from around the gate structure, dewatering of the gate facilities for inspection and maintenance, and replacement of riprap to repair eroded or damaged portions of the waterside levee slope. All in-water maintenance will be conducted within the in-water work window[3], in accordance with general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) including AMM1 *Worker Awareness Training;* AMM2 *Construction Best Management Practices and Monitoring;* AMM3 *Stormwater Pollution Prevention Plan;* AMM4 *Erosion and Sediment Control Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM14 *Hazardous Material Management Plan;* AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material;* and AMM7 *Barge Operations Plan*.

Maintenance dredging may be needed every 3 to 5 years to remove sediment that may potentially interfere with gate operations, navigation, and fish passage. Dredging will be conducted with a sealed clamshell dredge operated from a barge or from the top of the levee. A floating turbidity control curtain will be used to limit the dispersion of suspended sediment during dredging operations. Dredging will comply with the in-water work window[3] and turbidity standards, and will be performed as described in Appendix 3.F *General Avoidance and Minimization Measures*, AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material*.

Each gate bay will be inspected annually at the end of the wet season for sediment accumulation. Each miter or radial gate bay will include stop log guides and pockets for stop log posts to

facilitate the dewatering of individual bays for inspection and maintenance. Major maintenance could require a temporary cofferdam upstream and downstream for dewatering. When listed fish species may be present during dewatering operations, DWR will minimize potential stranding losses by implementing AMM8 *Fish Rescue and Salvage Plan*.

5.3.2.2.4 Clifton Court Forebay

Maintenance of the water conveyance facilities and other infrastructure at CCF (including Clifton Court Pumping Plant [CCPP], divider and perimeter embankments, outlet canals and siphons, South CCF [SCCF] intake structure, and North CCF [NCCF] emergency spillway) will include regular visual inspections and adjustments of the facilities to maintain compliance with engineering and performance standards, and periodic repairs to prevent mechanical, structural, and electrical failures. Emergency maintenance is also anticipated. Maintenance requirements potentially affecting listed fish species in CCF and Old River include dredging or mechanical excavation of accumulated sediment around the pumping, intake, and outlet facilities, and embankment maintenance activities, including repairs (e.g., RSP replacement) and vegetation control on the divider and perimeter embankments. With upstream sediment removal at the north Delta sedimentation facilities and expansion of storage capacity at CCF, the need for additional dredging of NCCF and SCCF over the first 50 years following construction is expected to be minimal. All in-water maintenance activities will be conducted within the in-water work window[3], in accordance with general take minimization measures (Appendix 3.F *General Avoidance and Minimization Measures*) including AMM1 *Worker Awareness Training;* AMM2 *Construction Best Management Practices and Monitoring;* AMM3 *Stormwater Pollution Prevention Plan;* AMM4 *Erosion and Sediment Control Plan;* AMM5 *Spill Prevention, Containment, and Countermeasure Plan;* AMM14 *Hazardous Material Management Plan;* AMM6 *Disposal and Reuse of Spoils, Reusable Tunnel Material, and Dredged Material;* and AMM7 *Barge Operations Plan*.

5.3.2.3 Operations

The primary instrument of minimization and avoidance of impact for listed fish species is compliance with the proposed operational constraints on the PP as detailed in Section 3.3.2 *Operational Criteria*, as further constrained in practice according to real-time operations as described in Section 3.3.3 *Real-Time Operational Decision-Making Process*. Operational constraints detailed in Section 3.3.4 *Operation of South Delta Facilities* and Section 3.3.5 *Water Transfers* also contribute to the avoidance and minimization of incidental take of listed fish species.

Aspects of facility design have also contributed to take avoidance and minimization. The NDDs will be provided with fish screens intended to minimize entrainment, impingement, fatigue and predation risks. Aspects of facility design intended to achieve these goals are detailed in Section 3.2.2.1 *Intake Design* and Section 3.2.2.2 *Fish Screen Design*. Moreover, a variety of preconstruction studies are proposed to aid in refinement of the fish screen design; see Chapter 6 *Monitoring Plan* for a listing and description of these studies.

In addition, Reasonable and Prudent Measures required under the existing USFWS (2008) biological opinion will continue to be implemented under the PP and serve as minimization

measures for the protection of Chinook salmon (see Table 1-2 *SWP Facilities and Actions Included and Not Included in the Proposed Project* for a full listing of the applicable USFWS actions). The existing commitments for operation of the NBA diversion stemming from the California Department of Fish and Game (2009) incidental take permit for longfin smelt, described in Section 3.3.2.6 Operational Criteria for the North Bay Aqueduct Intake, would also continue to be implemented under the PP and would serve to minimize the potential for longfin smelt entrainment and impingement.

Similarly, the Roaring River Distribution System (RRDS) water intake, consisting of eight 60-inch-diameter culverts, is equipped with fish screens (3/32-inch opening, or 2.4 mm) operated to maintain a screen approach velocity of 0.2 ft/s for longfin smelt protection, eliminating the risk of entrainment and minimizing the risk of impingement. Nothing in the PP would reduce this level of protection.

Herbicide treatment of aquatic weeds at CCF in July/August would avoid potential effects to longfin smelt because treatment would occur at a time when none of the longfin smelt life stages are expected to be present in CCF.

5.3.2.3.1 Effects of Sediment Removal at the North Delta Diversions

As described in Section 3.2.10.6 *Dispose Spoils*, the NDD is expected to divert a portion of the Sacramento River's sediment load, which could result in higher water clarity downstream because less sediment may over time allow greater erosion and less wind- and velocity-driven resuspension of sediment into the water column. To the maximum extent practicable, the first and preferred disposition of this material will be to reintroduce it to the water column in order to maintain Delta turbidity as a component of longfin smelt habitat. DWR will collaborate with USFWS and CDFW to develop and implement a sediment reintroduction plan that provides the desired beneficial habitat effects of maintained turbidity while addressing related permitting concerns (the proposed sediment reintroduction is expected to require permits from the Central Valley Regional Water Quality Control Board and USACE). CDFW, USFWS and NMFS will have approval authority for this plan and for monitoring measures, to be specified in the plan, to assess its effectiveness. Considering only the Sacramento River load at Freeport, it was estimated that a mean of 11% (range: 7–16%) of sediment load would be removed by the NDD. If this sediment, some of which will be collected in the sedimentation basins (described in Section 3.2.2 *North Delta Diversions*) is not returned to the system, it is possible that water transparency in the Delta will increase over time due to project operations. Note that the analysis did not attempt to provide a quantitative estimate for sediment removal by the south Delta export facilities under the NAA or PP; based on the estimates by Wright and Schoellhamer (2005), sediment removal by the south Delta export facilities in 1999-2002 averaged around 2% of the sediment entering the Delta at Freeport, i.e., an order of magnitude less than estimated to be removed at the NDD, so the net sediment removal under the PP (NDD exports plus less south Delta exports than NAA) would be expected to be appreciably greater than sediment removal under NAA. As described in Section 3.2.10.6, *Dispose Spoils*, in Chapter 3, DWR will collaborate with USFWS and CDFW to develop and implement a sediment reintroduction plan that provides the desired beneficial habitat effects of maintained turbidity while addressing related permitting concerns (the proposed sediment reintroduction is expected to require permits from the Water Control Board and USACE). This would minimize the effects of sediment removal by the NDD.

5.3.2.3.2 Effects of Spring Outflow

DWR has collaborated with CDFW to develop longfin smelt spring (March–May) outflow criteria that are consistent with existing water conveyance/operations including climate conditions. The proposed longfin smelt spring outflow criteria determine March outflow targets based on the Eight River Index[4] and achieve the targets with export curtailments down to a minimum of 1,500-cfs exports; the March outflow target is capped at 44,500 cfs at an Eight River Index of 4,217 TAF and greater (Table 5.3-1). April and May outflow targets are based on the San Joaquin River inflow:export ratio included in the NMFS (2009) BiOp, up to a maximum outflow target of 44,500 cfs; this again involves curtailment of exports as necessary.

Table 5.3-1. Proposed Longfin Smelt Spring Outflow Criteria: Monthly Net Delta Outflow Index in Relation to Eight River Index.

Eight River Index (March), TAF	Monthly Net Delta Outflow Index (March), cfs
0	0
545	6,200
1,488	8,800
1,911	12,700
2,140	17,100
2,421	20,000
2,575	25,200
3,104	35,000
3,492	43,700
≥4,217	44,500
Note: Net Delta Outflow Index targets are linearly interpolated for Eight River Index values falling between those shown on the table. This approach is based on the 90% forecast.	

The effectiveness of the proposed longfin smelt spring outflow criteria and the mechanisms underlying the importance of outflow will be a key component of a proposed scientific research program for longfin smelt, to be funded by and, as appropriate, participated in by DWR. The scientific research program will be a component of the adaptive management program described in Chapter 6 Monitoring Plan and Appendix 6.A Adaptive Management Framework. The longfin smelt scientific research program will aim to improve understanding of a number of factors related to the species, listed below with examples of particular aspects of interest:

- Longfin smelt biology;
- Mechanisms behind the Delta outflow-longfin smelt abundance relationship
    - Evidence for critical time periods (e.g., winter vs. spring)

[4] The Eight River Index refers to the sum of the unimpaired runoff for the following locations: Sacramento River flow at Bend Bridge, near Red Bluff; Feather River, total inflow to Oroville Reservoir; Yuba River flow at Smartville; American River, total inflow to Folsom Reservoir; Stanislaus River, total inflow to New Melones Reservoir; Tuolumne River, total inflow to Don Pedro Reservoir; Merced River, total inflow to Exchequer Reservoir; and San Joaquin River, total inflow to Millerton Lake.

- Annual variation in critical time periods;
- Evidence for the importance of retention in the low salinity zone and its variation with outflow

- Longfin smelt's use of tidal wetlands and potential for benefit from food production exported from restoration sites
  - Although only proposed under the PP to the extent needed to provide mitigation, other initiatives such as California EcoRestore would restore greater extents of tidal perennial habitat and therefore could benefit longfin smelt and other native fishes

- Longfin smelt occurrence in the Delta, Bay, and nearshore coastal ocean
  - Recent studies have suggested that the distribution of longfin smelt is broader than previously thought, with implications for assessing the population-level effects of the PP

5.3.3 Sacramento River Winter-Run Chinook Salmon

5.3.3.1 Contruction and Maintenance

General take minimization measures that will be implemented to avoid or minimize construction and facilities maintenance effects on Chinook salmon and steelhead are detailed in Appendix 3.F *General Avoidance and Minimization Measures* and are summarized in Table 3.2-2. General take minimization measures specifically applicable to Chinook salmon include AMMs 1 to 10, AMM14, AMM15, and AMM17. Furthermore, in-water activities associated with the proposed action will, as described in Section 3.2 *Conveyance Facility Construction*, comply with the proposed in-water work windows[5]. The general take minimization measures have been designed with the needs of all fish species (i.e., Delta smelt, longfin smelt, and both winter-run and spring-run Chinook salmon) in mind and thus are intended to minimize adverse effects upon all species. The expected effects upon each species are presented in Chapter 4 *Take Analysis*.

5.3.3.2 Operations

The primary instrument of minimization and avoidance of impact for Chinook salmon is compliance with the proposed operational constraints on the PP as detailed in Section 3.3.2 *Operational Criteria*, as further constrained in practice according to real-time operations as described in Section 3.3.3 *Real-Time Operational Decision-Making Process*. Operational constraints detailed in Section 3.3.4 *Operation of South Delta Facilities* and Section 3.3.5 *Water Transfers* also contribute to the avoidance and minimization of incidental take of Chinook salmon.

Aspects of facility design have also contributed to take avoidance and minimization. The NDDs will be provided with fish screens intended to minimize entrainment, impingement, fatigue and

[5] Proposed in-water work windows vary within the Delta: June 1 to October 31 at the NDDs, July 1 to November 30 at the CCF, and August 1 to October 31 at both the HOR Gate and the barge landings.

predation risks. Aspects of facility design intended to achieve these goals are detailed in Section 3.2.2.1 *Intake Design* and Section 3.2.2.2 *Fish Screen Design*. Moreover, a variety of preconstruction studies are proposed to aid in refinement of the fish screen design; see Chapter 6 *Monitoring Plan* for a listing and description of these studies.

In addition, actions required under the existing NMFS (2009a, 2011) biological opinion will continue to be implemented under the PP and serve as minimization measures for the protection of Chinook salmon (see Table 1-2 *SWP Facilities and Actions Included and Not Included in the Proposed Project* for a full listing of the applicable NMFS actions).

The existing commitments for operation of the NBA diversion stemming from the CDFG (2009) incidental take permit for longfin smelt, described in Section 3.3.2.6 *Operational Criteria for the North Bay Aqueduct Intake*, would also continue to be implemented under the PP and would serve to minimize the potential for Chinook salmon entrainment and impingement. Similarly, the Roaring River Distribution System (RRDS) water intake, consisting of eight 60-inch-diameter culverts, is equipped with fish screens (3/32-inch opening, or 2.4 mm) operated to maintain a screen approach velocity of 0.2 ft/s for Delta smelt protection but thereby also providing a very conservative level of protection for Chinook salmon. Nothing in the PP would reduce this level of protection.

Herbicide treatment of aquatic weeds in CCF in July/August would minimize risks to Chinook salmon because treatments would occur at the time when no Chinook salmon are expected to be present in the forebay.

Besides the foregoing general take minimization measures, two additional actions to minimize take are specific to the PP and are described below.

5.3.3.2.1 Nonphysical Fish Barrier at Georgiana Slough

Installation and seasonal operation of nonphysical barriers are hypothesized to improve survival of juvenile salmonids migrating downstream by guiding fish into channels in which they experience lower mortality rates (Welton et al. 2002; Bowen et al. 2012; Bowen and Bark 2012; Perry et al. 2014; California Department of Water Resources 2012b). The need to reduce juvenile salmonid entry into the interior Delta was recognized in the NMFS BiOp (2009a, 2011), which requires that engineering solutions be investigated to achieve a reduction in entrainment and that an approach be implemented if a NMFS-approved solution is identified by the process outlined in NMFS (2009a). Like other CVP/SWP operations, operation of any implemented engineering solution will be governed by the 2009 NMFS and 2008 USFWS biological opinions, the 2009 CDFW incidental take permit, and the related CDFW consistency determinations until the PP is operational; at that time, the operations of any barrier will be governed by the biological opinion(s) issued for the California WaterFix. This AMM does not directly offset the effect of the operation of the NDD (that is, it does not reduce the extent of harm to fish that pass the NDD). However, it is expected to provide a higher probability of survival for fish that pass the NDD and encounter the Sacramento River-Georgiana Slough junction since the reduced Sacramento River flows that result from the operation of the NDD could increase the potential for entrainment into Georgiana Slough.

Since 2011, DWR has been testing various engineering solutions in the Sacramento River at Georgiana Slough. Two types of structures have been tested at this location and are considered options for this take minimization measure. The first is a true nonphysical barrier that functions by inducing behavioral aversion to a noxious stimulus, e.g., visual or auditory deterrents (Noatch and Suski 2012). In 2011 and 2012 DWR tested a BioAcoustic Fish Fence (BAFF), which employs a three-component system comprising an acoustic deterrent within a bubble curtain that is illuminated by flashing strobe lights. The second type of structure, a floating fish guidance structure (FFGS), was tested in 2014. Though not a true nonphysical barrier because the structure contains physical screens, the structure induces behavioral aversion while essentially all the flow maintains its direction.

Because the design of the barrier associated with the PP has not yet been determined, construction of the barrier is not included in the PP and will instead be the subject of a separate 2081(b) application, completed prior to the initiation of NDD operations. At that time, the results of the investigations of various engineering solutions as required by the NMFS BiOp (2009a, 2011) are expected to be adequate to develop a proposal for barrier design, seasonal installation and removal, and detailed, design-specific protocols for operation. These design and operation specifics will be detailed in the associated 2081(b) application.

In 2011 and 2012, DWR began to study the effectiveness of a BAFF at the Georgiana Slough–Sacramento River junction in preventing outmigrating juvenile Chinook salmon from entering Georgiana Slough (California Department of Water Resources 2012b; Perry et al. 2014). This type of nonphysical barrier has shown promising results in field studies at other locations such as a field experiment on Atlantic salmon (*Salmo salar*) smolts in the River Frome, UK (Welton et al. 2002). For the studies at the Georgiana Slough junction, approximately 1,500 acoustically tagged juvenile late fall–run Chinook salmon produced at the Coleman National Fish Hatchery (and, in 2012, approximately 300 steelhead) were released into the Sacramento River upstream of Georgiana Slough and their downstream migrations past the BAFF and divergence with Georgiana Slough were monitored (California Department of Water Resources 2012b; Perry et al. 2014). During the 2011 study period, the percentage of salmon smolts passing the junction that were entrained into Georgiana Slough was reduced from 22.1% (barrier off) to 7.4% (barrier on) due to implementation of the barrier (California Department of Water Resources 2012b; Perry et al. 2014). This improvement produced an overall efficiency rate of 90.8%; that is, 90.8% of fish that entered the area when the barrier was on exited by continuing down the Sacramento River. There was some indication that the behavior and movement patterns of juvenile salmon were influenced by the high river flows that occurred in spring 2011. However, at high (> 0.25 meter per second) and low (< 0.25 meter per second) across-barrier velocities, BAFF operations resulted in statistically significant increases in overall efficiency for juvenile salmon.

A second evaluation of the BAFF system at this location in 2012, a much drier year than 2011, showed somewhat lower fish exclusion rates into Georgiana Slough. Exclusion rates were lower for both the barrier on and off conditions in 2012; however, the reduction in salmon entrainment with the barrier on was similar for both 2012 and 2011. During the 2012 study period, the percentage of salmon smolts passing the junction that were entrained into Georgiana Slough was reduced from 24.2% (barrier off) to 11.8% (barrier on) due to implementation of the barrier, with a similar reduction for steelhead (26.4% to 11.6%) (California Department of Water Resources

2015). This lower rate may be because of the notably lower river flow conditions in 2012 compared to 2011 (California Department of Water Resources 2015).

Perry et al. (2014) observed that fish more distant (i.e., across the channel) from the BAFF were less likely to be entrained into Georgiana Slough than those closer to the BAFF as they passed the slough, suggesting that guiding fish further away from the Georgiana Slough entrance would reduce entrainment into the slough. In essence, fish on the Georgiana Slough side of the critical streakline (the streamwise division of flow vectors entering each channel, or the location in the channel cross section where the parcels of water entering Georgiana Slough or remaining in the Sacramento River separate) have a higher probability of entering Georgiana Slough; by inducing a behavioral aversion to barrier stimuli, the BAFF increases the likelihood that fish remain on the Sacramento River side of the critical streakline. With this understanding, in 2014 DWR began a study of the effectiveness of a floating fish guidance structure at Georgiana Slough (California Department of Water Resources 2013). This structure uses steel panels suspended from floats to change water currents so that fish are guided towards the center of the river (away from the entrance to Georgiana Slough), but it does not substantially change the amount of water entering the slough. Studies of this technology in other locations have found it to be successful for guiding fish toward more desirable routes, e.g., at the Lower Granite Dam on the Snake River, Washington (Adams et al. 2001, as cited by Schilt 2007). This technology is considered as a potential design for this AMM because the large majority of flow does not change its destination; as with the BAFF, the structure's purpose is to keep fish on the Sacramento River side of the critical streakline. In contrast to the BAFF, the FFGS tested at Georgiana Slough in 2014 showed limited effectiveness. At intermediate discharge (200-400 m^3/s; ~7,000-14,000 cfs), juvenile Chinook salmon entry into Georgiana Slough was five percentage points lower when the FFGS was turned on (19.1% on; 23.9% off) (Romine et al. 2016). At higher discharge (>400 m^3/s), entry into Georgiana Slough was higher when the FFGS was turned on (19.3% on; 9.7% off), and at lower discharge (0-200 m^3/s) entry into Georgiana Slough was lower when the FFGS was turned on (43.7% on; 47.3% off). Overall entry into Georgiana Slough was 22% with the FFGS turned on, and 23% with the FFGS turned off. The results of the FFGS effectiveness study, coupled with the complex hydrodynamics of the Sacramento River-Georgiana Slough junction, suggest that dynamic deployment of an FFGS should be considered (Romine et al. 2016). For example, the greater entry into Georgiana Slough at higher flows could have been caused by turbulence around the structure, which could be decreased by angling the FFGS more toward shore at higher flows. Intermediate orientations, angles, lengths, and depths of FFGS could have resulted in different results. Overall, the results of the 2014 FFGS study suggest that this technology was less effective than the BAFF.

The uncertainties regarding the effectiveness of nonphysical barriers on all listed species, and at different flow rates, are continuing to be evaluated. While the response by juvenile hatchery-origin late fall–run Chinook salmon to the nonphysical barrier at Georgiana Slough appears positive, it does not necessarily reflect the response of other salmonids, particularly the smaller wild-origin winter-run (California Department of Water Resources 2012b) and spring-run Chinook salmon and young-of-the-year fall-run Chinook salmon.

Given the uncertainty of the structure design and the nascent science behind the effectiveness of any design at this location, the PP assumes that the operation of this AMM will provide a similar reduction in entrainment as was observed during the low flow conditions of 2012 when a BAFF

was deployed, as the existing results suggest that this technology may be more promising than an FFGS (recognizing that additional study of the latter is warranted).

5.3.3.2.2 Spring Outflow Criteria

As described in Section 4.2.7.2.2 *Effect of Take Minimization Measures* for longfin smelt, DWR and DFW have collaborated to propose spring Delta outflow criteria to fully mitigate potential adverse effects to longfin smelt (see also Section 5.3.2 *Longfin Smelt* in Chapter 5 *Take Minimization and Mitigation Measures*). This has been achieved through curtailment of exports at certain times. As such there would be essentially no difference in upstream operations between PP with longfin smelt spring outflow criteria and PP without such criteria for which the detailed analysis of upstream effects was presented in Section 4.3.4.2 *Upstream Hydrologic Changes*. This is reflected in little difference in May and September Shasta reservoir storage between these scenarios (Table 4.D-1 in Appendix 4.D *Comparison of Key Hydrological Variables for Proposed Project with Longfin Smelt Spring Outflow Criteria to No Action Alternative and Proposed Project Scenarios*). Within the Delta, reduction in south Delta exports to achieve longfin smelt spring outflow criteria would result in more positive Old and Middle River flows in March of below normal and dry water years in particular (Table 4.D-5 in Appendix 4.D), possibly providing a benefit to winter-run Chinook salmon in terms of improved south Delta hydrodynamics (although generally the effects would be expected to be similar to those described in Section 4.3.4.1 *Proposed Delta Exports and Related Hydrodynamics*). Per the longfin smelt spring outflow criteria (Section 5.3.2 *Longfin Smelt* in Chapter 5 *Take Minimization and Mitigation Measures*), the upper limit of the Delta outflow criteria of 44,500 cfs resulted in CalSim modeling giving somewhat greater north Delta exports in wet years for the PP with longfin smelt spring outflow criteria compared to PP, with the result that mean April flows in wet years below the NDD were around 1,600 cfs (5%) less under PP with longfin smelt spring outflow criteria compared to PP and therefore 12% less than NAA (Table 4.D-4 in Appendix 4.D). Given the very high flows at which the longfin smelt outflow criteria would cease, the leveling-off in through-Delta survival observed at high flows (Figure 5.D-45 in Appendix 5.D of ICF International [2016]; Figure 5 of Perry et al. [2016]) and the previously described take minimization measures of operational constraints, real-time operations, and Georgiana Slough nonphysical fish barrier, no additional effects are expected.

5.3.4 Central Valley Spring-Run Chinook Salmon

5.3.4.1 Contruction and Maintenance

General take minimization measures that will be implemented to avoid or minimize construction and facilities maintenance effects on Chinook salmon and steelhead are detailed in Appendix 3.F *General Avoidance and Minimization Measures* and are summarized in Table 3.2-2. General take minimization measures specifically applicable to Chinook salmon include AMMs 1 to 10, AMM14, AMM15, and AMM17. Furthermore, in-water activities associated with the proposed action will, as described in Section 3.2 *Conveyance Facility Construction*, comply with the proposed in-water work windows[6]. The general take minimization measures have been designed

[6] Proposed in-water work windows vary within the Delta: June 1 to October 31 at the NDDs, July 1 to November 30 at the CCF, and August 1 to October 31 at both the HOR Gate and the barge landings.

with the needs of all fish species (i.e., Delta smelt, longfin smelt, and both winter-run and spring-run Chinook salmon) in mind and thus are intended to minimize adverse effects upon all species. The expected effects upon each species are presented in Chapter 4 *Take Analysis*.

5.3.4.2 Operations

Avoidance and minimization measures pertinent to operations of the proposed facilities are fully detailed in Section 5.3.3.2 *Operations,* which see.

5.3.4.2.1 Nonphysical Fish Barrier at Georgiana Slough

The proposed nonphysical fish barrier at Georgiana Slough is fully detailed in Section 5.3.3.2.1 *Nonphysical Fish Barrier at Georgiana Slough,* which see.

5.3.4.2.2 Spring Outflow Criteria

As described in Section 4.2.7.2.2 *Effect of Take Minimization Measures* for longfin smelt, DWR and DFW have collaborated to propose spring Delta outflow criteria to fully mitigate potential adverse effects to longfin smelt (see also Section 5.3.2 *Longfin Smelt* in Chapter 5 *Take Minimization and Mitigation Measures*). This has been achieved through curtailment of exports at certain times. As such there would be essentially no difference in upstream operations between PP with longfin smelt spring outflow criteria and PP without such criteria for which the detailed analysis of upstream effects was presented in Section 4.3.4.2 *Upstream Hydrologic Changes*. This is reflected in little difference in May and September Shasta and Oroville reservoir storage between these scenarios (Tables 4.D-1 and 4.D-2 in Appendix 4.D *Comparison of Key Hydrological Variables for Proposed Project with Longfin Smelt Spring Outflow Criteria to No Action Alternative and Proposed Project Scenarios*). As described in Section 4.4.8.3 *Potential to Jeopardize Continued Existence of the Species*, within the Delta, reduction in south Delta exports to achieve longfin smelt spring outflow criteria would result in more positive Old and Middle River flows in March of below normal and dry water years in particular (Table 4.D-5 in Appendix 4.D), possibly providing a benefit to spring-run Chinook salmon in terms of improved south Delta hydrodynamics. Generally, however, the effects would be expected to be similar to those described in Section 4.4.4.1 *Proposed Delta Exports and Related Hydrodynamics*. The upper limit of the longfin smelt spring outflow criteria at 44,500 cfs resulted in CalSim modeling giving somewhat greater north Delta exports in wet years for the PP with longfin smelt spring outflow criteria compared to PP, with the result that mean April flows in wet years below the NDD were around 1,600 cfs (5%) less under PP with longfin smelt spring outflow criteria compared to PP and therefore 12% less than NAA (Table 4.D-4 in Appendix 4.D). Given the very high flows at which the longfin smelt outflow criteria would cease, the leveling-off in through-Delta survival observed at high flows, and the previously described take minimization measures of operational constraints, real-time operations, and Georgiana Slough, no additional effects are expected.

5.3.5 California Tiger Salamander

5.3.5.1 Suitable Habitat Definition

TMMs for California tiger salamander will be required for activities occurring within suitable cover and aestivation habitat, or wherever the species is encountered. Within the legal delta, based on the known distribution of the species, suitable habitat is defined to occur within the area west of the Yolo Basin but including the Tule Ranch Unit of the California Department of Fish and Wildlife (CDFW) Yolo Basin Wildlife Area; east of the Sacramento River between Freeport and Hood-Franklin Road; east of I-5 between Twin Cities Road and the Mokelumne River; and in the area south and west of SR 4 from Antioch (Bypass Road to Balfour Road to Brentwood Boulevard) to Byron Highway; then south and west along the county line to Byron Highway; then west of Byron Highway to Interstate 205 (I 205), north of I-205 to Interstate 580 (I 580), and west of I-580. Within this area, suitable terrestrial cover and aestivation habitat is defined as grassland with a minimum patch size of 100 acres (40.5 hectares), and suitable aquatic habitat is defined to consist of vernal pools, alkali seasonal wetlands, and stock ponds. See Figure 4.5-1 for a map depicting the modeled habitat in this region. Once a construction area has been cleared, it will no longer be considered suitable habitat.

An Approved Biologist[7] familiar with the species and its habitat will conduct a field evaluation of suitable upland or aquatic habitat for California tiger salamander for all activities in the PP that occur within suitable habitat or within areas of suitable habitat located by the Approved Biologist during the field evaluation (as described in Section 2.5.4, *Species Habitat Suitability Model* and Section 2.5.5, *Suitable Habitat Definition*).

5.3.5.1 Take Minimization Measures

5.3.5.1.1 Activities with Fixed Locations

TMMs are described below first for activities with known locations including the Clifton Court Forebay canal. Additional TMMs are then described for activities with uncertain locations: habitat restoration, transmission lines, and geotechnical exploration (for general TMMs see Appendix 3.F *General Avoidance and Minimization Measures*). No aquatic habitat for California tiger salamander will be affected. Workers will confine ground disturbance and habitat removal to the minimal area necessary to facilitate construction activities.

5.3.5.1.1.1 Site Preparation

- The perimeter of construction sites will be fenced with amphibian exclusion fencing within 14 days prior to the start of construction, and after excavating burrows as described below. Exclusion fencing will be 3-feet in height and buried to a depth of 6-inches and equipped with one-way exits to allow trapped California tiger salamander to escape. The Onsite Project Manager and the Approved Biologist, in cooperation with CDFW and USFWS, will determine where exclusion fencing will be installed to protect California tiger salamander habitat adjacent to the defined site footprint and to minimize the potential for California tiger salamanders to enter the construction work area. The

[7] The qualifications for an Approved Biologist include direct or contractual employment by DWR, and approval of suitability for work on the PP as stated in writing by representatives of CDFW.

locations of exclusion fencing will be determined, in part, by the locations of suitable habitat for the species. A conceptual fencing plan will be submitted to CDFW and USFWS prior to the start of construction and the California tiger salamander exclusion fencing will be shown on the final construction plans. DWR, as project applicant, will include the amphibian exclusion fence specifications including installation and maintenance criteria in the bid solicitation package special provisions, or this work will be done directly by DWR or DWR's contract biologists. The amphibian exclusion fencing will remain in place for the duration of construction and will be regularly inspected and fully maintained. The biological monitor and construction supervisor will be responsible for checking the exclusion fencing around the work areas daily to ensure that they are intact and upright. This will be especially critical during rain events, when flowing water can easily dislodge the fencing. Repairs to the amphibian exclusion fence will be made within 24 hours of discovery. Where construction access is necessary, gates will be installed with the exclusion fence. Refuge opportunities shall be provided on both sides of the barrier and shall consist of cover boards or straw wattles. Refuge areas shall be inspected each morning during and after rain events.

- At least 15 days prior to any ground disturbance activities, DWR, as project applicant, will prepare and submit a Relocation Plan for CDFW's written approval. The Relocation Plan will contain the name(s) of the CDFW-approved biologist(s) to relocate California tiger salamanders, the method of relocation (if different than described), a map, and a description of the proposed release site(s) within 300 feet of the work area or at a distance otherwise agreed to by CDFW, and written permission from the landowner to use their land as a relocation site.

- Preconstruction surveys will be conducted by a CDFW-approved biologist immediately prior to the initiation of any ground disturbing activities or vegetation clearing in areas identified as having suitable California tiger salamander habitat. Prior to initiating surveys, water trucks will spray the work area to influence emergence. Watering will occur at dusk, trucks will make a single pass, and the CDFW-approved biologist(s) will survey the watered area for one hour following the spraying. If California tiger salamander are found, they will be relocated consistent with the Relocation Plan described above. Also see *Species Observation and Handling Protocol*, below.

5.3.5.1.1.1.1 Initial Clearance/Ground Disturbance

- Workers will confine ground disturbance and habitat removal to the minimal area necessary to facilitate construction activities.

- Except for limited vegetation clearing necessary to minimize effects to nesting birds, initial suitable habitat clearance and disturbance will be confined to the dry season, generally May through October 15. All initial clearing will be limited to periods of no or low rainfall (less than 0.08 inches per 24-hour period and less than 40% chance of rain). Clearing activities within California tiger salamander habitat will cease 24 hours prior to a 40% or greater forecast of rain from the closest National Weather Service (NWS) weather station. Clearing may continue 24 hours after the rain ceases, if no precipitation is in the 24-hour forecast, after the site is surveyed by a CDFW-approved biologist. If clearing must continue when rain is forecast (greater than 40% chance of rain), a CDFW-

approved biologist will survey the worksite before clearing begins each day rain is forecast. If rain exceeds 0.5 inches during a 24-hour period, clearing will cease until the NWS forecasts no further rain. Modifications to this timing may be approved by CDFW based on site conditions and expected risks to California tiger salamanders. Once the ground has been cleared and perimeter fencing is in place, seasonal restrictions do not apply except that the CDFW-approved biologist will be onsite to check exclusion fencing during rain events as described below, with repairs made within 24 hours of finding any breaches in the fencing. .

5.3.5.1.1.1.2 During Construction

- The CDFW-approved biologist shall conduct clearance surveys at the beginning of each day and regularly throughout the workday when construction activities are occurring that may result in take of California tiger salamander. These surveys will consist of walking surveys within the worksites and investigating suitable aquatic and upland habitat including refugia habitat such as small woody debris, refuse, burrow entries, etc. All mammal burrows within the worksite limits that cannot be avoided will be hand-excavated and collapsed so that they do not attract California tiger salamanders during construction.

- If the exclusion fence is compromised during the rainy season, when California tiger salamanders are likely to be active, a survey will be conducted immediately preceding construction activity that occurs in suitable California tiger salamander habitat, as determined by the Approved Biologist, or in advance of any activity that may result in take of the species. The biologist will search along exclusion fences, in pipes, and beneath vehicles each morning before they are moved. The survey will include a careful inspection of all potential hiding spots, such as along exclusion fencing, large downed woody debris, and the perimeter of ponds, wetlands, and riparian areas. Any tiger salamanders found will be captured and relocated to suitable habitat with an active rodent burrow system at a location predetermined prior to commencement of construction in the Relocation Plan (as described below).

- To avoid entrapment of animals during construction, pipes or similar structures will be capped if stored overnight. Excavated holes and trenches will have escape ramps, and any open holes and trenches more than 6 inches deep will be closed with plywood at the end of each workday. The Approved Biologist will inspect all holes and trenches at the beginning of each workday and before the holes and trenches are filled. All pipes, culverts, or similar structures sored in the work area overnight will be inspected before they are subsequently moved, capped, and/or buried. If a California tiger salamander is discovered, the Onsite Project Manager and Approved Biologist will be notified immediately, and the Approved Biologist will move the animal to a safe nearby location (as described by the species observation and handling protocol below) and monitor it until it is determined that it is not imperiled by predators, or other dangers.

- Prior to trenching for exclusion fencing, mow vegetation along the work area fence line to the width necessary to accommodate the trenching equipment and a walking buffer to facilitate locating and avoiding burrows and California tiger salamanders that may be present within the project area. The Approved Biologist(s) will perform clearance surveys

within the work area that the Permittee will clear immediately prior to mowing and will be onsite during all activities that could result in take, i.e., mowing, trenching, vehicular access, etc. An Approved Biologist must be present on site during hand digging of holes or plant installation, in the event anyone observes the Covered Species on site.

- If verbally requested before, during, or upon completion of ground disturbance and construction activities where suitable California tiger salamander habitat is present, DWR, as project applicant, will ensure that CDFW and USFWS can immediately access and inspect the worksite for compliance with the description of the PP, and take minimization measures, and to evaluate effects on the California tiger salamander and its habitat.

- In each work area to be disturbed that is within 1.3 mile of known or potential breeding habitat for California tiger salamander and with no barriers to movement (e.g., tidal channel), all small mammal burrows within California tiger salamander habitat that cannot be fully avoided by at least 75 feet shall be fully excavated by hand under the direct supervision of the Approved Biologist. The excavation requirement applies regardless if the burrow is located within the Work Area or the Work Area's 75-foot buffer zone, unless a lesser distance from the Work Area for excavation is approved in writing by USFWS and CDFW. If a burrow is occupied, California tiger salamander must leave on its own volition or be relocated by the biologist before the burrow is excavated and collapsed.

- The Approved Biologist shall relocate any live California tiger salamanders discovered during burrow excavation in accordance with a Mortality Reduction and Relocation Plan that must be approved in writing by CDFW and USFWS. Excavation shall occur no more than 14 days after the completion of the California tiger salamander pre-construction surveys. Once the Approved Biologist determines the burrow is not occupied, the burrow shall be excavated and collapsed.

- The Approved Biologist will be onsite during all activities that may result in take of California tiger salamander. This biologist will carry a working mobile phone whose number will be provided to CDFW and USFWS prior to the start of construction and ground disturbance. CDFW and USFWS will consider the implementation of specific activities without the oversight of the Approved Biologist on a case-by-case basis.

- The Approved Biologist will contact the Construction Supervisor and project Environmental Program Manager immediately if they determine that any of take minimization measures are not being fulfilled, and the Environmental Program Manager will insure immediate corrective actions.

- The Approved Biologist will maintain monitoring records that include (1) the beginning and ending time of each day's monitoring effort; (2) a statement identifying the covered species encountered, including the time and location of the observation; (3) the time the specimen was identified and by whom and its condition;(4) the capture and release locations of each individual; (5) photographs and measurements (snout to vent and total length) of each individual; and (6) a description of any actions taken. The Approved

Biologist will maintain complete records in their possession while conducting monitoring activities and will immediately provide records to CDFW or USFWS upon request. If requested, all monitoring records will be provided to CDFW or USFWS within 30 days of the completion of monitoring work.

- To the extent possible, earthmoving and construction activities will cease no less than 30 minutes before sunset and will not begin again until no less than 30 minutes after sunrise within 300 feet of California tiger salamander habitat. Except when necessary for driver or pedestrian safety, to the greatest extent practicable, artificial lighting at a worksite will be prohibited during the hours of darkness. If artificial lighting cannot be avoided, the following measure will be implemented.

- If work must be conducted at night within 300 feet of California tiger salamander habitat, all lighting will be directed away and shielded from California tiger salamander habitat outside the construction area to minimize light spillover to the greatest extent possible. If light spillover into adjacent California tiger salamander habitat occurs, the Approved Biologist will be present during night work to survey for burrows and emerging California tiger salamanders in areas illuminated by construction lighting. If California tiger salamander is found above-ground the Approved Biologist has the authority to terminate the project activities until the light is directed away from the burrows, the California tiger salamander moves out of the illuminated area, or the California tiger salamander is relocated out of the illuminated area by the Approved Biologist.

- No rodenticides will be used during construction or long-term operational maintenance in areas that support suitable upland habitat for California tiger salamander.

- To prevent California tiger salamander from becoming entangled, trapped, or injured by erosion control structures, erosion control measures that use plastic or synthetic monofilament netting will not be used within areas designated to have suitable California tiger salamander habitat. This includes products that use photodegradable or biodegradable synthetic netting, which can take several months to decompose. Acceptable materials include natural fibers such as jute, coconut, twine, or other similar fibers. Following site restoration, erosion control materials, such as straw wattles, will be placed so as not to block movement of the California tiger salamander.

5.3.5.1.1.1.3 Species Observation and Handling Protocol

- If a California tiger salamander is observed, the Approved Biologist will implement the following species observation and handling protocol. Only the Approved Biologists will participate in activities associated with the capture, handling, and monitoring of California tiger salamanders. If a California tiger salamander is encountered in a construction area, activities within 75 feet of the individual will cease immediately and the Onsite Project Manager and Approved Biologist will be notified. Based on the professional judgment of the Approved Biologist, if activities at the worksite can be conducted without harming or injuring the California tiger salamander, it may be left at the location of discovery and monitored by the Approved Biologist. All personnel on site will be notified of the finding and at no time will work occur within 75 feet of the California tiger salamander without an Approved Biologist present. If it is determined by

the Approved Biologist that relocating the California tiger salamander is necessary, the following steps will be followed:

- Prior to handling and relocation, the Approved Biologist will take precautions to prevent introduction of amphibian diseases in accordance with the Interim Guidance on Site Assessment and Field Surveys for Determining Presence or a Negative Finding of the California Tiger Salamander (U.S. Fish and Wildlife Service 2003). Disinfecting equipment and clothing is especially important when biologists are coming to the project area to handle amphibians after working in other aquatic habitats. California tiger salamanders will also be handled and assessed according to the Restraint and Handling of Live Amphibians (U.S. Geological Survey National Wildlife Health Center 2001).

- California tiger salamanders will be captured by hand or other CDFW-approved methodology, transported, and relocated to nearby suitable habitat outside of the work area and released as soon as practicable the same day of capture. Individuals will be relocated no greater than 300 feet outside of the work area to areas with an active rodent burrow or burrow system (unless otherwise approved in writing by CDFW and USFWS). CDFW and USFWS will be notified within 24 hours of all capture, handling, and relocation efforts. The Approved Biologist will not use soaps, oils, creams, lotions, repellents, or solvents of any sort on their hands within two hours before and during periods when they are capturing and relocating individuals. To avoid transferring disease or pathogens of handling of the amphibians, the Approved Biologist will follow the Declining Amphibian Populations Task Force's "Code of Practice" (DAPTF 1998).

- If California tiger salamander is found either in the project area or during burrow excavations and is captured and handled for relocation, the Approved Biologist shall take tissue samples in accordance with methods approved by a Section 10a1(A) federal permit and a CDFW 2081(a) research MOU.

- The Approved Biologist shall notify CDFW and USFWS if a barred tiger salamander (Ambystoma tigrinum mavortium) or California tiger salamander-non native salamander hybrid is found within the project area within 24 hours by calling the Regional Office. CDFW, USFWS and DWR shall consult to determine measures to address non-native or hybrid populations.

- If an injured California tiger salamander is encountered and the Approved Biologist determines the injury is minor or healing and the salamander is likely to survive, the salamander will be released immediately, consistent with the pre-approved Relocation Plan as described above. The California tiger salamander will be monitored until it is determined that it is not imperiled by predators or other dangers.

- If the Approved Biologist determines that the California tiger salamander has major or serious injuries because of activities at the worksite, the Approved Biologist, or designee, will immediately take it to a facility approved in writing by CDFW and USFWS. If taken into captivity, the individual will not be released into the wild

unless it has been kept in quarantine and the release is authorized in writing by CDFW and USFWS. DWR, as project applicant, will bear any costs associated with the care or treatment of such injured California tiger salamanders. The circumstances of the injury, the procedure followed and the final disposition of the injured animal will be documented in a written incident report. Notification to CDFW and USFWS of an injured or dead California tiger salamander in the project area will be made as described under the Reporting Requirements measure (described above), and reported whether or not its condition resulted from activities related to the PP. In addition, the Approved Biologist will follow up with CDFW and USFWS in writing within two calendar days of the finding. Written notification to CDFW and USFWS will include the following information: the species, number of animals taken or injured, sex (if known), date, time, location of the incident or of the finding of a dead or injured animal, how the individual was taken, photographs of the specific animal, the names of the persons who observe the take and/or found the animal, and any other pertinent information. Dead specimens will be preserved, as appropriate, and held in a secure location until instructions are received from the CDFW and USFWS regarding the disposition of the specimen.

5.3.5.1.2 Activities with Flexible Locations

5.3.5.1.2.1 Geotechnical Exploration

Geotechnical exploration will be sited outside of California tiger salamander aquatic habitat. Geotechnical exploration within suitable upland habitat will include the following measures, adopted from the September 3, 2010 BiOp on *Engineering Geotechnical Studies for the Bay Delta Conservation Plan (BDCP) and/or the Preliminary Engineering Studies for the Delta Habitat Conservation and Conveyance Program (DHCCP)* (81410-2010-F-0022). After the final geotechnical exploration locations have been determined, the take minimization measures described in Section 5.3.5.2.1 *Activities with Fixed Locations*, will be followed.

- To the extent practicable, all project activities will avoid impacts to grassland habitat that possess cracks or burrows that could be occupied by California tiger salamanders within 100 feet (30 m) of suitable aquatic breeding habitat. If this is not practicable, access routes and drill sites will be sited to avoid ground squirrel burrows.

- Movement of heavy equipment (e.g., large vehicles such as trucks, backhoes, vehicle-mounted equipment, etc.), will be minimized in suitable California tiger salamander upland habitat to minimize habitat disturbance. If this is not practicable, heavy equipment routes will avoid ground squirrel burrows.

- Pre-construction surveys will be conducted by an Approved Biologist. An Approved Biologist will be present during all drilling activities to ensure there are no significant impacts to California tiger salamander.

- Work will be done outside the wet season (November through April) and measures, such as having vehicles follow shortest possible routes from levee road to the drill or CPT sites, will be taken to minimize the overall project footprint.

- Geotechnical exploration activities will cease no less than 30 minutes before sunset and will not begin again until no less than 30 minutes after sunrise within 300 feet of California tiger salamander habitat.

5.3.5.1.2.2 Power Supply and Grid Connections

The final transmission line alignments will be sited to avoid California tiger salamander aquatic habitat, and to minimize effects on upland habitat. The transmission lines will be sited at least 300 feet from occupied California tiger salamander aquatic habitat as determined through protocol-level surveys of any suitable aquatic habitat within the potential transmission line alignment. Occupancy may be assumed, in order to forego the need for protocol-level surveys. After the final transmission line alignment has been determined, the take minimization measures described in Section 5.3.5.2.1, *Activities with Fixed Locations,* will be followed, with the following exception:

- Transmission line construction activities will cease no less than 30 minutes before sunset and will not begin again until no less than 30 minutes after sunrise within 300 feet of California tiger salamander habitat.

5.3.5.1.2.3 Safe Havens

Safe havens will avoid suitable California tiger salamander habitat.

5.3.6 Giant Garter Snake

5.3.6.1 Suitable Habitat Definition

Section 2.6.4 *Species Habitat Suitability Model* defines suitable habitat and describes the habitat model for giant garter snake. The habitat model was created to conservatively estimate effects to habitat, because access to activity areas is not possible at this time. During project implementation and prior to project construction, DWR, in agreement with CDFW and USFWS, will:

1. Develop a giant garter snake habitat description to be used to identify suitable habitat within the area of modeled habitat at each site, when each site becomes available for surveys.

2. When each site is available for surveys, a giant garter snake expert, approved by USFWS and CDFW, will use the agreed habitat description to delineate giant garter snake habitat at each project site, including both aquatic and upland habitat.

3. Once habitat has been delineated, the giant garter snake expert may use giant garter snake surveys performed using a method approved by the CDFW and USFWS to determine presence/absence of the species on the project site to enable further determination of mitigation requirements as described in Section 5.4.6.1 *Compensation for Effects*.

4. For sites where such surveys are performed, the surveys will conform to protocol and reporting needs per a plan to be jointly developed by DWR, CDFW and USFWS to provide population and occurrence data for the species in the Delta.

To the greatest extent possible, identified and delineated habitat within the work area will be completely avoided. For those habitats that can be avoided within the work area, including small mammal burrows, a high visibility poly wire will be erected to protect suitable giant garter snake upland habitat at least 200 feet from the edge of aquatic giant garter snake habitat. Stakes will be installed by the Approved Biologist and placed every six feet along the boundary. The high visibility poly wire will be raised at least four feet above grade. The high visibility wire and stakes shall be marked with high visibility flagging or markers. Signs identifying the disturbance-free area will be placed every 50 feet along the edge of the habitat. Signs will be clearly visible, recognizable to construction staff, and maintained as needed.

5. When avoidance is not possible, the measures discussed in Section 5.3.6.2 *Take Minimization Measures* are required.

5.3.6.2 Take Minimization Measures

Take minimization measures for giant garter snakes will be required for activities occurring within suitable aquatic and upland habitat. For general TMMs see Appendix 3.F *General Avoidance and Minimization Measures*).

5.3.6.2.1 Activities with Fixed Locations

Activities with fixed locations include all construction activities described in Section 3.2, *Conveyance Facility Construction,* except geotechnical exploration, and transmission lines. DWR will implement the following TMMs for construction, operation, and maintenance related to fixed location activities in delineated habitat. DWR will also implement the following measures for activities with flexible locations once their locations have been fixed, if they occur in delineated habitat.

The Approved Biologist[8] shall conduct two days of walking pre-construction surveys in each construction area located within suitable giant garter snake habitat beginning no more than seven (7) days prior to initiating ground disturbing activities. The final survey shall occur the day preceding ground disturbing activities in the work area. The measures listed also apply to activities which will require access through suitable habitat.

- Avoid construction activities on suitable giant garter snake upland habitat within 200 feet of the banks of suitable giant garter snake aquatic habitat during the inactive period, i.e., between October 1 and May 1, by clearing the habitat and installing exclusionary fencing during the active period. Suitability of aquatic and upland habitat characteristics will be determined by the Approved Biologist consistent with the habitat description outlined in Section 2.6.4 *Species Habitat Suitability Model*.
- If construction and maintenance activities cannot be avoided in giant garter snake upland habitat between October 1 and May 1, confine these activities to the minimum amount

[8] The qualifications for an Approved Biologist include direct or contractual employment by DWR, and approval of suitability for work on the PP as stated in writing by representatives of CDFW.

necessary and follow the minimization measures below. The aquatic/wetland habitat located at the southern tip of Zacharias Island on the inside portion of the levees, which could serve as suitable habitat for giant garter snake, will be fully avoided by project-related construction activity.

- To the extent practicable, conduct all activities within paved roads, farm roads, road shoulders, and similarly disturbed and compacted areas; confine ground disturbance and habitat removal to the minimal area necessary to facilitate construction activities. Where paved roads, farm roads, and similarly disturbed areas cannot be avoided, follow the take minimization measures herein.

- For construction activities, dredging, and any conveyance facility maintenance involving heavy equipment (i.e., heavy duty vehicles specially designed for construction tasks and earthwork operations; examples include backhoes, vehicle-mounted equipment, etc.), giant garter snake aquatic and upland habitat adjacent to the disturbance area will be clearly delineated on the work site, with exclusionary fencing and signage identifying these areas as sensitive. The exclusionary fencing will be installed during the active period for giant garter snake (May 1 to October 1), no less than 30 days in advance of the disturbance and immediately after pre-construction surveys have been completed, and after any giant garter snakes present have left or been moved out of harm's way. The exclusionary fencing will consist of 3-foot-tall non-monofilament silt fencing extending to 6 inches below ground level. The fence will be designed with a lip to prevent giant garter snakes from climbing over the barrier and with the wooden stakes on the project side of the fence. At any access opening in the fence, the fence shall turn 80 degrees away from the access point for a length of approximately 10 feet and at a minimum width of one foot from the original barrier. All changes in the fence design shall be submitted to CDFW and USFWS no less than 30 days prior to the proposed start of project activities and approved in writing by CDFW and USFWS before exclusion fence installation.

- Preconstruction surveys, installation of exclusionary fencing, aquatic habitat dewatering, and site clearing, will occur during the active season only.

- Vegetation will be maintained within one meter on the side of the exclusionary fence away from the project area(s) at a maximum height of four inches. Hand tools (e.g., trimmer, chainsaw, etc.) will be used to trim or remove vegetation. All vegetation removal shall be monitored by the Approved Biologist to minimize impacts to giant garter snake.

- Damage to small mammal burrows in suitable giant garter snake habitat will be avoided to the maximum extent possible during installation of the exclusion fence. The Approved Biologist shall oversee the construction of the exclusion barrier to ensure giant garter snake are not killed or injured during barrier installation. When burrows cannot be avoided, burrows shall be hand excavated by the Approved Biologist prior to fence trenching activities. GGS found during excavation shall be relocated as described above. Following excavation, the Approved Biologist shall block holes or burrows which appear to extend under the barrier to minimize GGS movement into the Work Area(s).

- Prior to trenching for fence installation, mow vegetation along the work area fence line to the width necessary to accommodate the trenching equipment and a walking buffer to facilitate locating and avoiding burrows and giant garter snakes that may be present within the project area. The Approved Biologist(s) will perform clearance surveys within the work area that the Permittee will clear immediately prior to mowing and will be onsite during all irrigation installation activities that could result in take, i.e., mowing, trenching, vehicular access, etc. An Approved Biologist must be present on site during hand digging of holes or plant installation, in the event anyone observes the Covered Species on site.

- For activities requiring exclusionary fencing, the biological monitor and construction supervisor will be responsible for checking the exclusionary fences around the work areas daily and after storm events (rainfall exceeding 0.5 inches during a 24-hour period) to ensure that they are intact and upright. Any necessary repairs will be immediately addressed. The exclusionary fencing will remain in place for the duration of construction. After exclusionary fencing is in place and within 24 hours prior to construction, the biological monitor will survey suitable habitat outside the fencing and search for giant garter snake inside the fencing, in case giant garter snake got inside the fencing during the gap in time between placement of the fencing and initiation of construction. For additional detail on exclusionary fencing type, size, and height, see Appendix 3.F *General Avoidance and Minimization Measures,* AMM2 *Construction Best Management Practices and Monitoring*.

- If exclusionary fencing is found to be compromised, a survey of the exclusion fencing and the area inside the fencing will be conducted immediately preceding construction activity that occurs in delineated giant garter snake habitat or in advance of any activity that may result in take of the species. The biologist will search along exclusionary fences, in pipes, and beneath vehicles before they are moved. Any giant garter snake found will be captured and relocated to suitable habitat a minimum of 200 feet outside of the work area in a location that is approved by USFWS and CDFW prior to resumption of construction activity.

- All construction personnel, and personnel involved in operations and maintenance in or near giant garter snake habitat, will attend worker environmental awareness training as described in Appendix 3.F *General Avoidance and Minimization Measures*, AMM1 *Worker Awareness Training*. This training will include instructions to workers on how to recognize giant garter snakes, their habitat(s), and the nature and purpose of protection measures.

- Within 24 hours prior to construction activities, dredging, or maintenance activities requiring heavy equipment, the Approved Biologist will survey all suitable habitat within the activity area not protected by exclusionary fencing where giant garter snake could be present. This survey of the work area will be repeated if a lapse in construction or dredging activity of two weeks or greater occurs during the inactive period (October 1 to May 1) or if the lapse in construction activity is more than 12 hours during the active period (May 1 to October 1). If a giant garter snake is encountered during surveys or construction, cease activities until appropriate corrective measures have been completed,

it has been determined that the giant garter snake will not be harmed, or the giant garter snake has left the work area. If giant garter snakes are situated in such a manner that they are unable or unlikely to leave the work area on their own, the Approved Biologist will relocate the giant garter snake to suitable habitat a minimum of 200 feet outside of the work area in a location that is approved by USFWS and CDFW prior to resumption of construction activity.

- The Approved Biologist will help guide access and construction work around wetlands, active rice fields, and other sensitive habitats capable of supporting giant garter snake, to minimize habitat disturbance and risk of injuring or killing giant garter snakes.

- Report all observations of giant garter snakes to the Approved Biologist. Giant garter snake encountered in the construction footprint will be allowed to leave on their own volition. The Approved Biologist will only relocate giant garter snake if the animal is directly threatened by immediate construction activities or the animal is unable to move to a safe area on its own.

- Develop a Mortality Reduction and Relocation Plan (Relocation Plan) for giant garter snake and submit it to CDFW and USFWS for written approval no less than 30 days prior to initiating construction activities. Permittee shall include in the Relocation Plan at a minimum the proposed giant garter snake capture and handling technique; and a quantification of the amount, relative location, and quality of suitable habitat (aquatic and terrestrial), including invasive and non-native species present, available upland burrows, suitable prey items, and potential barriers for movement of relocation site(s).

- Maintain all construction and operations and maintenance equipment to prevent leaks of fuel, lubricants, and other fluids and use extreme caution when handling and or storing chemicals (such as fuel and hydraulic fluid) near waterways, and abide by all applicable laws and regulations. Follow all applicable hazardous waste best management practices (BMPs) and keep appropriate materials on site to contain, manage, and clean up any spills as described in Appendix 3.F *General Avoidance and Minimization Measures*, AMM5 *Spill Prevention, Containment, and Countermeasure Plan.*

- Conduct service and refueling procedures in uplands in staging areas and at least 200 feet away from giant garter snake upland habitat and waterways when practicable. See also Appendix 3.F *General Avoidance and Minimization Measures*, AMM5 *Spill Prevention, Containment, and Countermeasure Plan*.

- During construction and operation and maintenance activities in and near giant garter snake habitat, employ erosion (non-monofilament silt fence), sediment, material stockpile, and dust control (BMPs on site). Avoid fill or runoff into wetland areas or waterways to the extent practicable.

- Return temporary work areas to pre-existing contours and conditions as is reasonable upon completion of work. Where re-vegetation and soil stabilization are necessary in non-agricultural habitats, revegetate with appropriate non-invasive native plants at a density and structure similar to that of pre-construction conditions.

- Properly contain and remove from the worksite all trash and waste items generated by construction and crew activities to prevent the encouragement of predators such as raccoons and coyotes from occupying the site.

- Permit no pets, campfires, or firearms at the worksite.

- Store equipment in designated staging area areas at least 200 feet away from giant garter snake aquatic habitat or in areas protected by exclusion fencing.

- Confine any vegetation clearing to the minimum area necessary to facilitate construction activities.

- Limit vehicle speed to 10 miles per hour (mph) on access routes (except for public roads and highways) and within work areas that are within 200 feet of giant garter snake aquatic habitat but not protected by exclusion fencing to avoid running over giant garter snakes.

- Visually check for giant garter snake under vehicles and equipment prior to moving them. Workers or the Approved Biologist will visually inspect and materials (conduits, pipe, etc.) and then cap all materials onsite, precluding wildlife from becoming entrapped. Check any crevices or cavities in the work area where individuals may be present including stockpiles that have been left for more than 24 hours where cracks/crevices may have formed.

- For proposed activities that will occur within unavoidable suitable aquatic giant garter snake habitat, all aquatic giant garter snake habitat will be dewatered for at least 15 days prior to excavating or filling the dewatered habitat. De-watering is necessary because aquatic habitat provides prey and cover for giant garter snake; de-watering serves to remove the attractant, and increase the likelihood that giant garter snake will move to other available habitat. Any deviation from this measure will be done in coordination with, and with written approval of, CDFW and USFWS.

- Following de-watering of aquatic habitat, all potential impact areas that provide suitable aquatic or upland giant garter snake habitat will be surveyed for giant garter snake by the Approved Biologist. If giant garter snakes are observed, they will be passively allowed to leave the potential impact area, or the CDFW and USFWS will be consulted to determine the appropriate course of action for removing giant garter snake from the potential impact area.

- One of the following methods will be used to handle natural debris (debris composed of on-site vegetation, usually removed from waterways; debris does not include spoils from dredging):

    - Debris shall be placed in piles 200 feet from aquatic habitat. Debris piles shall not be disturbed or removed once placed.

    - Debris shall be immediately hauled off-site for disposal.

Maintenance activities such as vegetation and rodent control, embankment repair, and channel maintenance will occur at conveyance facilities with permanent structures (e.g., NDD, pumping plant, etc.). The following take minimization measures will be applied to maintenance activities in suitable aquatic habitat and uplands within 200 feet of suitable aquatic habitat, to minimize effects on the giant garter snake.

- Vegetation control will take place during the active period (May 1 through October 1) when snakes are able to move out of areas of activity.

- Trapping or hunting methods will be used for rodent control, rather than poison bait. All rodent control methods will be approved by CDFW and USFWS. If trapping or other non-poison methods are ineffective, the CDFW and USFWS will be consulted to determine the best course of action.

- Within suitable upland habitat, movement of heavy equipment will be confined to outside 200 feet of the banks of giant garter snake aquatic habitat, or within areas protected by exclusion fencing, to minimize habitat disturbance.

- All construction personnel, and personnel involved in operations and maintenance in or near giant garter snake habitat, will attend worker environmental awareness training as described in Appendix 3.F *General Avoidance and Minimization Measures*, AMM1 *Worker Awareness Training*. This training will include instructions to workers on how to recognize giant garter snakes, their habitat(s), and the nature and purpose of protection measures.

- Operations and maintenance activities will avoid habitat during the inactive season for giant garter snake when possible. When this is not possible, operations and maintenance activities will follow the take minimization measures listed above. Activities with Flexible Locations.

- Noise effects will be minimized as described in Appendix 3.F *General Avoidance and Minimization Measures*, AMM13 *Noise Abatement.* However, since these measures will only be implemented where practicable, some residual effects resulting from noise and vibrations are anticipated near giant garter snake habitat. Due to the long-term nature of the activities, giant garter snakes may habituate to these disturbances. DWR will monitor giant garter snake habitat immediately adjacent to the construction footprint prior to and during construction activities that could produce significant vibration outside the project footprint to determine if giant garter snakes are present and if they appear to be affected and report those findings to CDFW.

5.3.6.2.1.1 Activities with Flexible Locations

Activities with flexible locations are activities that cannot yet be precisely sited because they require design or site-specific information that will not be available until the PP is already in progress. These include geotechnical exploration, safe haven intervention sites, transmission lines, and habitat restoration. Access to these activities will also follow the take minimization measures herein.

5.3.6.2.1.1.1 Geotechnical Activities

Geotechnical activities will avoid giant garter snake aquatic habitat. To the extent practicable, all activities within giant garter snake habitat, as delineated by the Approved Biologist, will avoid impacts to suitable uplands within 200 feet of suitable aquatic habitat. The following take minimization measures will be used to minimize effects on the giant garter snake.

- If construction takes place during the inactive period (October 1 to May 1), activities on suitable upland giant garter snake habitat within 200 feet from the banks of giant garter snake aquatic habitat will be avoided.

- Movement of heavy equipment (e.g., large vehicles such as trucks, backhoes, vehicle-mounted equipment, etc.) will avoid suitable upland giant garter snake habitat within 200 feet of the banks of suitable giant garter snake aquatic habitat to minimize habitat disturbance.

- Construction personnel will receive worker environmental awareness training, approved by CDFW and USFWS, instructing workers to recognize giant garter snakes and their habitat.

- Limit speed limit to 10 miles per hours within giant garter snake upland habitat, within project work areas and access routes.

- The Approved Biologist shall be on-site during selection of drill site, ingress, and egress, and during set-up activities to guide project personnel to avoid visible burrows until avoidance routes are clearly established.

- The Approved Biologist shall either flag burrows to be avoided by a margin of at least 50 feet, or designate and flag a work area and ingress/egress routes that avoid potentially occupied areas.

- If a snake is detected retreating into or exiting a burrow, the burrow shall be avoided by a margin of at least 50 feet.

- Upon completion of the project, all areas subject to temporary ground disturbances, including storage and staging areas, temporary roads, pipeline corridors, will be re-contoured to pre-project elevations, as appropriate and necessary, and revegetated with native vegetation, or other appropriate vegetation selected in consultation with CDFW, to promote restoration of the area to pre-project conditions. An area subject to "temporary" disturbance is any area that is disturbed to allow for construction of the project, but is not required for operation or maintenance of any project-related infrastructure, will not be subject to further disturbance after project completion, and has the potential to be revegetated. Appropriate methods and native plant species, or other appropriate plant species, used to revegetate such areas will be determined on a site-specific basis in consultation with CDFW and the approved biologist.

5.3.6.2.1.1.2 Safe Haven Work Areas

Safe haven work areas will avoid giant garter snake aquatic and upland habitat.

5.3.6.2.1.1.3 Power Lines and Grid Connections

The power lines and grid connections will avoid impacts to giant garter snake aquatic habitat. Additional giant garter snake take minimization measures for transmission lines will be the same as described in Section 5.3.6.2.1 *Activities with Fixed Locations.* In addition, upon completion of the project, all areas subject to temporary ground disturbances, including storage and staging areas, temporary roads, pipeline corridors, will be recontoured to pre-project elevations, as appropriate and necessary, and revegetated with native vegetation, or other appropriate vegetation as agreed upon in writing by USFWS and CDFW, to promote restoration of the area to pre-project conditions. An area subject to "temporary" disturbance is any area that is disturbed to allow for construction of the project, but is not required for operation or maintenance of any project-related infrastructure, will not be subject to further disturbance after project completion, and has the potential to be revegetated. Appropriate methods and native plant species, or other appropriate plant species, used to revegetate such areas will be determined on a site-specific basis in consultation with USFWS and CDFW and the approved biologist.

5.3.6.2.1.1.3.1 Maintenance

Maintenance activities such as vegetation and rodent control, embankment repair, and channel maintenance will occur at conveyance facility and restoration sites with flexible locations (e.g., transmission line right of ways, etc.). The following take minimization measures will be applied to maintenance activities in suitable aquatic habitat, as delineated by the Approved Biologist, and uplands within 200 feet of suitable aquatic habitat, to minimize effects on the giant garter snake.

- Vegetation control will take place during the active period (May 1 to October 1) when snakes are able to move out of areas of activity.

- Trapping or hunting methods will be used for rodent control, rather than poison bait. All rodent control methods will be approved by CDFW and USFWS. If trapping or other non-poison methods are ineffective, the CDFW and USFWS will be consulted to determine the best course of action.

- Movement of heavy equipment will be confined to outside 200 feet of the banks of potential giant garter snake habitat to minimize habitat disturbance.

- The Approved Biologist shall be on-site during selection of ingress and egress, and during set-up activities to guide project personnel to avoid visible burrows until avoidance routes are clearly established.

- The Approved Biologist shall either flag burrows to be avoided by a margin of at least 50 feet, or designate and flag a work area and ingress/egress routes that avoid potentially occupied areas.

- Construction personnel will receive worker environmental awareness training, approved by CDFW and USFWS, instructing workers to recognize giant garter snakes and their habitat.

Maintenance activities that cannot avoid giant garter snake habitat will implement the take minimization measures described in Section 5.3.6.2.1 *Activities with Fixed Locations*.

5.3.7 Swainson's Hawk

5.3.7.1 Suitable Habitat Definition

Swainson's hawk suitable habitat is defined in Section 2.7.5 *Suitable Habitat Definition*. The Swainson's hawk habitat model, described in Section 2.7.4 *Species Habitat Suitability Model*, was created to conservatively estimate effects to habitat because access to the activity areas to perform surveys is not possible at this time. Nesting habitat terms used in the effects analysis, and in the take minimization measure below (e.g., suitable nesting habitat, active nest, occupied nest, affected nest sites), are defined in Section 4.7 *Take of the Swainson's Hawk.*

5.3.7.2 Take Minimization Measures

Take minimization for Swainson's hawk will only be required for projects and operations and maintenance activities occurring within suitable nesting and foraging habitat as defined in Section 2.7.5 *Suitable Habitat Definition*. An Approved Biologist[9] familiar with the species and its habitat will conduct a field evaluation to verify the locations of nests for all covered activities that occur within modeled habitat, or within additional areas of potentially suitable habitat located by an Approved Biologist during the field evaluation.

Take minimization measures (TMMs) are described below first for project activities with known locations including the NDDs, RTM placement areas, the IF, maintenance dredging for HOR Gate, and the CCF. Additional TMMs are then described for project activities with uncertain locations: geotechnical investigations, and transmission line construction. For general TMMs see Appendix 3.F *General Avoidance and Minimization Measures*.

5.3.7.2.1 Activities with Known Locations

Construction at most project sites along the tunnel alignment will be extensive and long in duration. Flexibility in scheduling project activities will extremely limited, as will modifications to project footprint. Multiple pairs of Swainson's hawks will very likely nest within ¼ mile of construction activities, and potentially much closer, even after construction activities reach peak activity levels. The measures listed below will minimize the likelihood of construction-induced nest failure, but not all protections can be implemented at all times, and it is possible that construction will occur in close proximity to nesting Swainson's hawks, and it is possible that one or more Swainson's hawk nests will fail because of construction disturbance.

Swainson's hawks tend not to be vulnerable to construction disturbance, and often construct nests near existing construction sites or other human-disturbance areas. Construction activities have a sliding scale of risk to nesting Swainson's hawks, from high to low: physical contact with the nest tree, activities that occur close to the nest at nest height or above, human activity close to the nest tree, and mechanical activity close to the nest tree. In general, as the distance between the nest and activity increases, risk to nesting success declines. In rare instances, Swainson's hawk pairs have shown themselves to be particularly sensitive to humans close to their nests

[9] The qualifications for an *Approved Biologist* include direct or contractual employment by DWR, and approval of suitability for work on the PP as stated in writing by representatives of CDFW and USFWS.

(very rarely, mechanical disturbances) if they see them, but even loud construction noise does not tend to affect them.

The following measures will be implemented with the understanding that no-activity buffers cannot be guaranteed in all instances, construction in most cases cannot be stopped, rescheduled, or moved, and construction cannot be limited to a 10-hour day. It could be extremely costly to the project to stop construction, and in many cases dangerous.

The following measures will be required for activities occurring in suitable Swainson's hawk habitat:

- Preconstruction surveys will be conducted by the Approved Biologist to identify the presence of potential Swainson's hawk nest trees on and within 1/4 mile of project sites, staging and storage areas, construction access roads, work areas and soil stockpile areas; transportation routes along public roads (roads leading to and from work areas) are considered disturbed, and no surveys or monitoring are required for nests along those roadways unless they are within ¼ mile of work areas. Surveys for nesting Swainson's hawks will be conducted in all potential nesting habitat identified above, and will be consistent with the *Recommended Timing and Methodology for Swainson's Hawk Nesting Surveys in California's Central Valley* (Swainson's Hawk Technical Advisory Committee 2000), or as the methodology is modified with written approval from CDFW. Survey results will be provided to CDFW by phone or e-mail no less than 5 days prior to commencement of construction activities, and in a written report within 30 days after commencement of construction activities. The Approved Biologist will include the location of any known nest trees (occupied within one or more of the last five years) present within ¼ mile of the construction footprint.

- Removal of known nest trees will be avoided to the maximum extent feasible. In the event that a known nest tree needs to be removed for project related activities, CDFW will be notified in writing of the location of the known nest tree and timing of removal. No trees with occupied nests will be removed until the nest is vacated. The tree replacement protocol described below will be followed to offset affected nest sites, or may be modified with written authorization from CDFW.

- The Approved Biologist will survey potential Swainson's hawk nest trees and monitor occupied Swainson's hawk nests as described below. When proposed construction will occur within 1/4 mile of known nest trees, activities will be limited to outside the breeding season[10] if feasible, or until the tree site is determined to be inactive.

- Where construction activities cannot be restricted to more than ¼ mile of an occupied nest site, activities will be restricted during the period of egg-laying to post-hatching to the extent feasible. If construction activities must occur in that time frame, construction will be initiated prior to egg-laying to the extent feasible. This will allow time for

[10] The breeding or nesting season is defined as being between March 1 and September 15, or between March 1 and August 15 if a Management Authorization is in place (CDFG 1994). For the purposes of this project, the breeding or nesting season can be modified by the approved biologist with approval in writing from CDFW.

Swainson's hawks to acclimate to disturbance before eggs are laid, reducing the potential for abandonment. If construction activities must begin after egg laying is initiated, a 650-foot radius no-activity buffer will be established at least until eggs have hatched.

- When construction activities will occur within ¼ mile of an occupied Swainson's hawk nest, a 650-foot-radius no-activity buffer will be established around each occupied nest tree. To the greatest extent feasible, no construction activity will be allowed to occur within the buffer while a Swainson's hawk nest is occupied; a nest is considered occupied from the time the nest is being constructed until the young leave the nest, or until the nesting attempt fails and the nest is abandoned. Occupied nests will be monitored to track progress of nesting activities. The buffer will be clearly delineated with fencing or other conspicuous marking. CDFW will be notified if construction activities must take place within 650 feet of an active nest site (tree), and additional measures protection measures will be implemented as described below.

- Where construction activities will occur within ¼ mile of an occupied Swainson's hawk nest tree, the following monitoring plan will be implemented. If a nesting bird monitoring and management plan is prepared by an Approved Biologist, and approved in writing by CDFW, it will prevail where it differs from the measures below.

    - Five days and three days prior to the initiation of construction at any site where an occupied nest is within 1/4 mile of construction, the Approved Biologist will observe the subject nest(s) for at least 1 hour and until nest status can be determined. Nest status will be determined and nesting behaviors documented, which may be used to compare to the hawks' activities once construction begins. The results of preconstruction monitoring will be reported to CDFW within 24 hours of each survey.

    - Where an occupied Swainson's hawk nest occurs less than 325 feet from construction activities, the Approved Biologist will observe the nest periodically throughout the day where covered activities occur to ensure the hawks are engaged in normal nesting behavior.

    - Where a Swainson's hawk occupied nest occurs between 325 and 650 feet of construction, the Approved Biologist will observe the nest for at least 2 hours per day where covered activities occur to ensure the hawks are involved with normal nesting behavior.

    - Where a Swainson's hawk occupied nest occurs between 650 and 1,300 feet of construction, the approved biologist will observe the nest for at least 3 days per construction week to ensure the hawks are involved with normal nesting behavior and to check the status of the nest.

- Physical contact with an occupied nest tree will be prohibited from the time of egg laying to fledging, unless CDFW consents in writing to the contact. Construction personnel outside of vehicles will be restricted to greater than 650 feet, or the length of the buffer

approved in writing by CDFW, from the occupied nest tree unless construction activities require them to be closer.

- All personnel will be out of the line of sight of the occupied nest during breaks if within 650 feet of the nest (as stated above, activities can only occur within 650 feet of a nest with written approval by CDFW).

- If during construction the Approved Biologist determines that a nesting Swainson's hawk within ¼ mile of the project is disturbed by project activities, to the point where there is a potential for take of the nest, the Approved Biologist will immediately notify the Construction Supervisor and Program Environmental Manager. The Program Environmental Manager will contact CDFW, and it will be determined by the parties whether additional protection measures can be implemented. Potential nest abandonment and failure may be indicated if the Swainson's hawks exhibit distress and/or abnormal nesting behavior such as swooping/stooping at construction equipment or personnel, excessive vocalization [distress calls]or agitation directed at construction personnel, failure to remain on nest, or failure to deliver prey items for an extended time period. Additional protection measures will remain in place until the Swainson's hawk behavior has normalized. The Approved Biologist will notify CDFW if nests or nestlings are abandoned and if the nestlings are still alive to determine appropriate actions for salvaging the eggs or returning nestlings to the wild.

5.3.7.2.2 Activities with Flexible Locations

In addition to the measures described above under *Activities with Known Locations*, the following measures will be implemented for activities for which the extent and location of the activity has not yet been fully planned.

- Geotechnical exploration activities will fully avoid Swainson's hawk nesting habitat. Geotechnical exploration will not be conducted within ¼ mile of an occupied Swainson's hawk nest.

- Safe haven work area activities will avoid Swainson's hawk nesting habitat, and will fully avoid Swainson's hawk occupied nest trees and take of individuals through the measures described above in Section 5.3.7.2.1 *Activities with Known Locations*.

- Transmission line activities will minimize loss of Swainson's hawk nesting habitat, and will avoid occupied nests and take of individuals, through the measures described above in Section 5.3.7.2.1 *Activities with Known Locations*.

- Helicopters will not be used to string transmission lines or conduct other activities with flexible locations within ¼ mile of an active Swainson's hawk nest.

- To minimize the potential for strike with transmission lines, bird strike diverters will be installed on all new permanent and temporary lines. For optimum results, the diverters will be spaced along the lines in accordance with the Avian Powerline Interaction Committee's guidance (Avian Power Line Interaction Committee 2012) and the most

effective and appropriate diverter for minimizing strikes on the market according to best available science will be selected. Bird strike diverters will be installed in a configuration that research indicates will reduce bird strike risk by at least 60% or more. Bird strike diverters will be placed on a length of existing transmission lines equivalent to the length of new permanent and temporary lines constructed, unless the new lines replace existing lines. Bird strike diverters placed on new and existing lines will be periodically inspected and replaced as needed until or unless the project or existing line is removed, or are otherwise no longer a strike risk for Swainson's hawk.

- During powerline maintenance, workers will follow the AMMs described above in Section 5.3.7.2.2, *Activities with Known Locations.* No active nest trees will be removed during maintenance.

5.3.8 Tricolored Blackbird

5.3.8.1 Suitable Habitat Definition

Tricolored blackbird suitable habitat is defined in Section 2.8.5 *Suitable Habitat Definition*. The tricolored blackbird habitat model, described in Section 2.8.4 *Species Habitat Suitability Model*, was created to conservatively estimate effects to habitat because access to the activity areas to perform surveys is not possible at this time. During project implementation and prior to project construction, DWR in agreement with CDFW, will identify suitable habitat at sites to be impacted based on the definition in Section 2.8.5. The following measures will be implemented in and within 1,300 feet from suitable tricolored blackbird habitat.

5.3.8.2 Take Minimization Measures

5.3.8.2.1 Activities with Fixed Locations

5.3.8.2.1.1 Nesting Habitat

Prior to initiation of construction at a site within 1,300 feet of suitable nesting habitat, a CDFW-approved biologist with experience surveying for and observing tricolored blackbird will conduct preconstruction surveys to establish use of nesting habitat by tricolored blackbird colonies. Surveys will be conducted in suitable habitat (as defined in Section 2.8.5 *Suitable Habitat Definition*.) within 1,300 feet of proposed construction areas, where access allows, during the nesting season (generally March 15 to July 31) 1 year prior to, and then again the year of, construction. During each year, surveys will be conducted monthly in March, April, May, June, and July. If construction is initiated at a site during the nesting season, 3 surveys will be conducted within 15 days prior to construction with one of the surveys within 5 days prior to the start of construction. If active tricolored blackbird nesting colonies are identified, the following avoidance measure will be implemented.

- Activities under the proposed action must avoid active tricolored blackbird nesting colonies and associated habitat during the breeding season (generally March 15–July 31) to the extent practicable within 1,300 feet from an active tricolored blackbird nesting colony. Where a buffer distance of 1,300 feet is not practicable, a buffer distance of a minimum of 300 feet shall be established. This minimum buffer may be reduced in areas

with dense forest, buildings, or other habitat features between the construction activities and the active nest colony, or where there is sufficient topographic relief to protect the colony from excessive noise or visual disturbance as determined by a CDFW approved biologist experienced with tricolored blackbird. If tricolored blackbirds colonize habitat adjacent to construction after construction has been initiated, DWR will reduce disturbance through establishment of buffers and/or sound curtains, as determined by a CDFW approved biologist experienced with tricolored blackbird.

5.3.8.2.1.2 Roosting Habitat

Prior to initiation of construction at a proposed action project site within 300 feet of suitable roosting habitat, a CDFW-approved biologist with experience surveying for and observing tricolored blackbirds will conduct preconstruction surveys to establish use of roosting habitat by tricolored blackbird colonies. Surveys will be conducted in suitable habitat (as defined in Section 2.8.5 *Suitable Habitat Definition*) within 300 feet of proposed construction areas during the nonbreeding season (generally August 1 to March 14) 1 year prior to, and then again the year of, construction. If construction is initiated at a site during the nonbreeding season, 3 surveys will be conducted within 15 days prior to construction with one of the surveys within 5 days prior to the start of construction.

- Construction and restoration projects will be designed, in consultation with CDFW, to avoid construction activity within at least 300 feet from occupied active tricolored blackbird roosting habitat. This minimum buffer may be reduced in areas with dense forest, buildings, or other habitat features between the construction activities and the active nest colony, or where there is sufficient topographic relief to protect the roosting site from excessive noise or visual disturbance, or where sound curtains are used, as determined by a CDFW-approved biologist experienced with tricolored blackbird.

- Activities under the proposed action that are within 300 feet of occupied roosting habitat will be monitored by a CDFW-approved biologist familiar with tricolored blackbird behavior patterns to verify that the activity is not disrupting the roosting birds. If it is, the activity will be modified, as practicable, by delaying construction until the blackbirds are no longer using the roosting site, temporarily relocating staging areas, temporarily rerouting access to the construction site, or use of sound curtains. The CDFW-approved biologist will evaluate the non-disturbance buffer distance on a case-by-case basis.

Upon completion of the PP, all areas subject to temporary ground disturbances, including storage and staging areas, temporary roads, pipeline corridors, will be recontoured to pre-project elevations, as appropriate and necessary, and revegetated with native vegetation, or other appropriate vegetation as agreed upon in writing by CDFW, to promote restoration of the area to pre-project conditions. An area subject to "temporary" disturbance is any area that is disturbed to allow for construction of the project, but is not required for operation or maintenance of any project-related infrastructure, will not be subject to further disturbance after project completion, and has the potential to be revegetated. Appropriate methods and native plant species, or other appropriate plant species, used to revegetate such areas will be determined on a site-specific basis in consultation with CDFW and the approved biologist.

5.3.8.2.2 Activities with Flexible Locations

In addition to the measures described above under *Activities with Fixed Locations*, the following measures will be implemented for activities for which the extent and location of the activity has not yet been fully planned.

- Geotechnical exploration activities and transmission lines activities will fully avoid tricolored blackbird nesting and roosting habitat. These activities will also avoid take of individuals through the measures described in Section 5.3.8.2.1 *Activities with Fixed Locations*.

- Helicopters will not be used to string transmission lines within 300 feet of active tricolored blackbird colonies.

- Safe haven work area and ventilation shaft activities will fully avoid tricolored blackbird nesting and roosting habitat.

- Restoration activities will minimize effects on tricolored blackbird and its habitat, and will avoid occupied nest sites and take of individuals through the measures described above in Section 5.3.8.2.1 *Activities with Fixed Locations*. Restoration, however, is not a component of the PP and DWR is not seeking take authorization for restoration activities at this time.

5.3.9 Mason's Lilaeopsis

AMMs for Mason's lilaeopsis will only be required for projects and operations and maintenance activities occurring within suitable habitat as defined in Section 2.9.5 *Suitable Habitat Definition*.

Take minimization measures are described below first for project activities with known locations including the expansion of Clifton Court Forebay and associated work areas. Additional AMMs are then described for project activities with uncertain locations: geotechnical investigations, transmission line construction, and habitat restoration.

5.3.9.1 Project Activities with Known Locations

Impacts on extant Mason's lilaeopsis occurrences will be minimized through implementation of the following measures:

- Prior to water conveyance facility construction, a complete botanical survey of construction areas will be completed using *Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed and Candidate Plants* (U.S. Fish and Wildlife Service 1996) and *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities* (California Department of Fish and Game 2009). The surveys will be floristic in nature and conducted in a manner that maximizes the likelihood of locating special-status plant species or special-status natural communities that may be present (i.e., during the appropriate season and tidal height, and at an appropriate level of ground coverage).

Results from floristic surveys will be submitted to CDFW no more than 30 days after completion.

- Construction and soil disturbing activities occurring on levees will be conducted on the levee crowns and landward side of levees. Roads will never be widened on the water side of the levees.

- Where Mason' lilaeopsis occurrences are found:

    - Silt fences will be installed on the waterward side of levees to minimize movement of sediment onto existing Mason's lilaeopsis plants.

    - AMM4 Erosion and Sediment Control Plan (Table 3-3) will be implemented to minimize the release and movement of sediment which could be harmful to Mason's lilaeopsis.

- To minimize the spread of nonnative, invasive plant species to restoration sites, DWR will retain a qualified botanist or weed scientist prior to clearing operations to determine if affected areas contain invasive plants. If areas to be cleared contain invasive plants, then chipped vegetation material from those areas will not be used for erosion control; in these cases the material will be disposed of to minimize the spread of invasive plant propagules (e.g., burning, composting).

- Infestations of invasive plant species will be targeted for control or eradication as part of the restoration and revegetation of temporarily disturbed construction areas adjacent to Mason's lilaeopsis suitable habitat. This measure does not apply to the routine management, maintenance, and educational activities of DWR within protected lands.

5.3.9.2 Project Activities with Uncertain Locations

In addition to the measures described above under Section 5.3.9.1 *Project Activities with Known Locations*, the following measures will be implemented for activities for which the extent and location of the activity has not yet been fully planned.

- Geotechnical exploration activities, safe havens, and the construction of transmission lines for the covered activity will fully avoid effects on Mason's lilaeopsis occurrences and habitat.

- Surveys for Mason's lilaeopsis will be conducted during the planning phase to allow design of the individual restoration projects to avoid impacts on habitat for Mason's lilaeopsis. The purpose of these surveys will be to verify that the locations of Mason's lilaeopsis identified in previous record searches or surveys are extant, identify any new Mason's lilaeopsis occurrences, and cover any portions of the project area not previously identified. Locations of Mason's lilaeopsis in proposed construction areas will be recorded using a GPS unit and flagged. Pre-project surveys will estimate the area covered by Mason's lilaeopsis individuals in the impacted habitat to ensure sufficient mitigation.

5.4 Mitigation Measures

Mitigation measures are intended to fully mitigate the effects of the PP on listed species. This section describes measures to mitigate adverse effects. This section also details the protection and restoration needed to meet the species-specific compensation commitments. The compensation commitments provided in this section are based on discussions with CDFW, NMFS, and USFWS, taking into account the quality of habitat to be impacted relative to quality of the proposed compensation areas.

All mitigation sites will be protected or constructed (as applicable) prior to the occurrence of the impacts being mitigated. Since construction of the PP will entail a period of more than a decade, some impacts will occur early in the process, while others will be much later; throughout the PP, mitigation will continue to accrue prior to the impacts being mitigated. DWR will track this process and provide summary reports to the CDFW, NMFS, and USFWS at not less than annual time-steps, demonstrating that mitigation has been provided in advance of impacts.

The protection of land requires no on-the-ground action or disturbance and thus has no potential to adversely affect species. Properly sited land protection will benefit listed species of wildlife by expanding and connecting existing protected lands. Grassland and vernal pool habitats will be protected to benefit Swainson's hawk, San Joaquin kit fox, tricolored blackbird, and California tiger salamander. For details regarding the siting of lands that will be protected to benefit these species, see Section 5.4.0.4, *Spatial Extent, Location, and Design of Restoration for Listed Species of Wildlife*.

Enhancement and management, and monitoring on protected and restored lands have potential to have some minor effects. For example, individuals could be harmed or harassed by management vehicles or personnel. These effects will be minimized through education and training, as described in Appendix 3.F, *General Avoidance and Minimization Measures*. Monitoring will be performed by qualified biologists. If handling of the species is necessary, this work will be done by qualified personnel with appropriate scientific collection permits.

Construction associated with the PP (Section 3.2, *Conveyance Facility Construction*) will result in the permanent and temporary removal of suitable habitat for listed species. Construction-related effects will be minimized through design, and through avoidance and minimization measures, as described in Section 5.3 *Take Minimization Measures*. The mitigation measures include compensation to fully mitigate the loss of habitat for listed species that occurs as a result of restoration actions to be implemented for the mitigation of effects of construction and/or operation of the proposed facilities on listed species and wetlands. These restoration actions are components of the PP and are intended to meet requirements pursuant to various laws and regulations including the California Endangered Species Act, the California Environmental Quality Act, the National Environmental Policy Act, and the Clean Water Act. All lands protected as compensation for effects on habitat will be owned in fee title or through conservation easements, or will be included in approved conservation banks. All such lands will be protected and maintained, in the manner described in this section, in perpetuity. The methods for quantifying loss of listed species habitat from restoration activities are described in Appendix 4.B, *Terrestrial Effects Analysis Methods*.

5.4.0 Framework for Mitigation Design

This section describes the types of effects that require compensation and general approach to determining compensation, and summarizes the protection and restoration required to meet the species-specific compensation commitments presented in this section.

The proposed project includes a number of activities that are expected to cause few to no effects on listed species and therefore will not require compensation. These activities include acquisition and protection of mitigation lands, the enhancement and management of protected and restored lands, and monitoring. This protection, enhancement, management, and monitoring will be implemented to compensate for effects to both state and federally listed species. The protection of land requires no on-the-ground action or disturbance and thus has no potential to adversely affect species. Properly sited land protection will benefit species by expanding and connecting existing protected lands. Grassland and vernal pool habitats will be protected to benefit California tiger salamander. For details regarding the siting of lands that will be protected to benefit each of the covered state listed species, see Sections 5.4.1 through 5.4.9, below.

The spatial extent and location of restoration and protection for state and federally listed species is described below, in Section 5.4.0.3 *Spatial Extent, Location, and Design of Restoration for Fish Species* and Section 5.4.0.4 *Spatial Extent, Location, and Design of Restoration for Listed Species of Wildlife.* While actual impacts and compensation will be determined on an annual basis during construction of the PP, maximum impact limits are set to define the upper bounds of effects to listed species' suitable habitat. Protection and restoration to compensate for habitat and wetland loss will be implemented prior to the effects associated with the PP. DWR will calculate and report actual construction impacts annually. Restoration and protection will be accomplished prior to the impact.

While compensation needs will be calculated during construction, conservative estimates of potential total impact to listed species' suitable habitat have been used to determine take limits for each species, as described for each species below. If during implementation it is determined that take may exceed the limit for any species, the applicants will apply for a 2081 permit amendment.

5.4.0.1 Restoration and Protection Site Management Plans

DWR, as project applicant, will prepare and implement a management plan for each listed species habitat restoration and protection site. Management plans may be for an individual parcel or for multiple parcels that share common management needs. Reclamation and DWR will conduct surveys to collect the information necessary to assess the ecological condition and function of conserved species habitats and supporting ecosystem processes, and based on the results, will identify actions necessary to achieve the desired habitat condition at each site.

Management plans will be prepared in collaboration with CDFW, NMFS, and USFWS, consistent with their authority, and submitted to those agencies for approval within 2 years of the acquisition of each site. This schedule is designed to allow time for site inventories and identification of appropriate management techniques. During the interim period, management of the site will occur using best practices and based on successful management at the same site prior

to acquisition or based on management at other similar sites. The plans will be working documents that are updated and revised as needed to incorporate new acquisitions suitable for coverage under the same management plan and to document changes in management approach that have been agreed to by Reclamation, DWR, and the appropriate wildlife agency or agencies (CDFW, NMFS, and USFWS), consistent with their authority.

Each management plan will include, but not be limited to, descriptions of the following elements.

- The species-specific objectives to be achieved with management of each site covered by the plan.
- Baseline ecological conditions (e.g., habitat maps, assessment of listed species habitat functions, occurrence of listed species and other native wildlife species, vegetation structure and composition, assessment of nonnative species abundance and effect on habitat functions, occurrence and extent of nonnative species).
- Vegetation management actions that benefit natural communities and listed species and reduce fuel loads, as appropriate, and that are necessary to achieve the management plan objectives.
- If applicable, a fire management plan developed in coordination with the appropriate agencies and, to the extent practicable, consistent with achieving the management plan objectives.
- Infrastructure, hazards, and easements.
- Existing and adjacent land uses and management practices and their relationship to listed species habitat functions.
- Applicable permit terms and conditions.
- Terms and conditions of conservation easements when applicable.
- Management actions and schedules.
- Monitoring requirements and schedules.
- Established data acquisition and analysis protocols.
- Established data and report preservation, indexing, and repository protocols.
- Adaptive management approach.
- Any other information relevant to management of the preserved parcels.

Management plans will be periodically updated to incorporate changes in maintenance, management, and monitoring requirements as they may occur.

Based on the assessment of existing site conditions (e.g., soils, hydrology, vegetation, occurrence of listed species) and site constraints (e.g., location and size), and depending on biological objectives of the restoration sites, management plans will specify measures for enhancing and maintaining habitat as appropriate.

5.4.0.2 Conservation Banking

To provide protection and restoration in a timely manner without incurring temporal loss of listed species habitat, DWR may use existing conservation banks, establish its own conservation banks, or provide habitat protection/restoration in advance of anticipated impacts.

DWR may opt to use existing conservation banks to meet its mitigation needs for listed species. An example is the Mountain House Conservation Bank in eastern Alameda County. This bank has available conservation credits for San Joaquin kit fox and California tiger salamander; the PP is in the service area for this bank for both species. However, no approved conservation banks in the vicinity of the project area could address the needs of the other listed wildlife species, or of listed species of fish.

DWR may also opt to create its own conservation banks, subject to conclusion of appropriate agreements with CDFW and/or USFWS, as applicable (noting that no such banks are included in the PP and no such agreements have yet been concluded). If such banks are operational at the time impacts accrue under the PP, DWR may then use bank credits to mitigate for impacts incurred under the PP. Protection and restoration of grasslands, riparian woodlands, and nontidal wetlands may be suitable subjects for this approach.

5.4.0.3 Summary of Restoration for Fish Species

Similar to the listed species of wildlife, the precise siting of parcels used to achieve habitat restoration for listed species of fish has yet to be determined. In consequence, this application does not seek take coverage for the performance of habitat restoration; rather, restoration sites will be subject to site-specific 2081(b) permits, to be obtained by DWR prior to performance of restoration. The following descriptions of restoration actions mitigating effects to listed fish species, however, describes in general terms how and where restoration will be sited and constructed.

Given species occurrence locations and habitat requirements, the regions where restoration is likely to occur can be generally defined. Impact maxima have been determined for each species and summarized in Table 5.4-1. The mitigation measures provide for the restoration of suitable habitat for Delta smelt, longfin smelt, winter-run Chinook salmon, and spring-run Chinook salmon. Subsequent sections of this chapter detail how the mitigation specified in Table 5.4-1 achieves full mitigation for each species.

The PP will occur, and its effects will be expressed, within habitat for each of the fish species, which encompasses waters throughout the entire legal Delta. DWR will develop the siting and design of each individual tidal and channel margin restoration site consistent with the performance standards set by CDFW, USFWS and/or NMFS; final selection of restoration sites will be subject to these agencies' concurrence as applicable. Each restoration site will be

managed in accordance with a site-specific management plan as described in Section 5.4.0.1 *Restoration and Protection Site Management Plans*.

Table 5.4-1 relies on the analyses presented in Chapter 4 *Take Analysis* pertaining to the permanent and temporary construction and operation effects on fish habitat. A GIS analysis was used to determine the acreage of effect for each structure, including areas located in habitat that could be affected by placement of permanent in-water structures, and the temporary areas of effect (i.e., areas that will only be affected during construction activities; although all Delta smelt habitat impacts are considered permanent because they are typically an annual fish). Although there will be dredging and other construction-related disturbances in the Clifton Court Forebay, it is not considered suitable habitat for any of the listed species, and the AMMs associated with construction will minimize effects.

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Table 5.4-1. Summary of Maximum Direct Impact, Proposed Compensation, and Potential Location of Restoration for State Listed Fish Species

Resource	Location of Impact	Maximum Direct Impacts		Mitigation Ratio	Total Compensation, Restoration by Impact Area	Total Compensation, Restoration	Potential Location of Proposed Restoration
		Total Impacts					
		Permanent	Temporary				
Chinook salmon (both winter-run and spring-run)							
Channel margin habitat (linear miles)	North Delta Diversions	Construction: 1.02; operations: 0.42	0 (occur within same footprint as permanent impacts)	3:1	4.3	4.3 miles	Sacramento River, Steamboat and Sutter Sloughs, or other areas agreed to by NMFS and CDFW[1]
Tidal perennial habitat (acres)	North Delta Diversions	6.6	20.1	3:1	80.1	154.8 acres	Sherman Island, North Delta, South Delta, or other areas agreed to by NMFS and CDFW, commensurate to area of specific effect
	Head of Old River[2]	2.9	0	3:1	7.5		
	Barge Landings[2]	22.4	0	3:1	67.2		
Delta smelt							
Shallow water habitat (acres)	North Delta Diversions (intake + wing wall transitions + 1,000 feet downstream suspended sediment effect)	5.6	All impacts are considered permanent to Delta smelt because of the species' predominantly one-year life cycle	5:1[3]	28	347.7 acres (of which 273 acres must be shallow water habitat [including 108 acres of sandy beach spawning habitat], and 74.7 acres must be tidal perennial habitat)	Sherman Island, Cache Slough, North Delta or other areas agreed to by USFWS and CDFW
Shallow water habitat (acres)	Habitat upstream of North Delta Diversions[4]	245 (of which 36 is sandy beach spawning habitat)		Overall 1:1, with 3:1 for sandy beach spawning habitat	245 (of which 108 acres must be sandy beach spawning habitat)		
Tidal perennial habitat (acres)	Head of Old River[2]	2.9		3:1	7.5		
	Barge Landings	22.4		3:1	67.2		
Longfin smelt							
Shallow water habitat (acres)	North Delta Diversions (intake + wing wall transitions + 1,000 feet downstream suspended sediment effect)	5.6	All impacts are considered permanent to longfin smelt because of the species' predominantly two-year life cycle	5:1[3]	28	347.7 acres (of which 273 acres must be shallow water habitat [including 108 acres of sandy beach spawning habitat], and 74.7 acres must be tidal perennial habitat)	Sherman Island, Cache Slough, North Delta or other areas agreed to by USFWS and CDFW
Upstream shallow water habitat (acres)	Shallow water habitat upstream of the North Delta Diversions[4]	245 (of which 36 is sandy beach spawning habitat)		Overall 1:1, with 3:1 for sandy beach spawning habitat	245 (of which 108 acres must be sandy beach spawning habitat)		
Tidal perennial habitat (acres)	Head of Old River[2]	2.9		3:1	7.5		
	Barge Landings	22.4		3:1	67.2		

[1] For purposes of estimating impacts of proposed restoration, it was assumed restoration will occur on the Sacramento River or Sutter or Steamboat Sloughs.

[2] The impacts of the temporary rock barrier have been mitigated, and therefore approximately 0.5 acres of impact is not assigned to the PP (i.e. mitigation ratios apply to 2.5 acres of impact, not to 2.9 acres). Mitigation is shown here as consisting of tidal perennial habitat but, subject to CDFW, NMFS and USFWS approval, may also include some amount of channel margin mitigation.

[3] The 5:1 mitigation ratio assumes in-water work in June; should work not occur in June, the ratio will be 3:1. This may vary by intake.

[4] The mitigation is for potential reduced access to shallow water habitat because of the higher shoreline velocities expected from the NDD.

[5] The 245 acres estimate is based on 250 total acres from downstream end of intake 5 to I Street bridge, Sacramento, minus the footprint of the three intakes + wing wall transitions and associated in-water work during construction (3.7 acres) + acreage 1000 feet downstream of intakes 2 and 3 (1.3 acres) because of suspended sediment; these acreages are already accounted for with the direct impact from the NDD.

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Summary of Restoration for Wildlife and Plant Species

The spatial extent of restoration and protection activities will be determined by the spatial extent of impacts and the applied mitigation ratios. While actual impacts and compensation will be determined on an annual basis during construction of the PP, as detailed in Section 5.4.0.1 *Restoration and Protection Site Management Plans*, maximum impact limits will be set to define the upper bounds of effects on suitable habitat for listed species of wildlife. Table 5.4-2 summarizes the maximum impact limit, mitigation ratios, and total proposed compensation. This includes compensation for fully protected species, and for species protected under ESA, because this compensation is a component of the PP. Any take of listed species associated with this restoration, however, will not be covered under the incidental take permit issued for the PP, and would need to be covered under a separate take authorization. Such a take authorization request would be submitted subsequent to site selection for the proposed restoration.

The precise siting of parcels used to achieve habitat restoration and protection has yet to be determined. Compensation will be sited near the location of impacts if and when practicable and feasible. The restoration locations will be determined in coordination with CDFW staff. Siting criteria for restoration activities are detailed in the species-specific subsections of Chapter 5.

Table 5.4-2. Summary of Maximum Direct Impact, Proposed Compensation, and Potential Location of Restoration and Protection for State and Federally Listed Species of Wildlife[11]

Resource	Maximum Direct Impacts		Mitigation Ratios		Total Proposed Compensation if All Impacts Occur		Potential Location of Proposed Restoration and Protection
	Total Impacts						
	Permanent (Acres)	Temporary (Acres)	Protection	Restoration	Total Compensation, Protection	Total Compensation, Restoration	
Swainson's hawk							
Foraging habitat	3,769	980	1:1	-	3,769	0	North, east, and south Delta
Nesting habitat	22	0	1:1	1:1	22	22	North or east Delta
Tricolored blackbird							
Foraging habitat - breeding	2,063	165	1:1	0	2,063	0	North, east, and south Delta
Foraging habitat - nonbreeding	1,774	377	1:1	0	1,774	0	North, east, central, and south Delta
Nesting	16	0	3:1		48		North, east, and south Delta
Roosting	20	0	2:1		20 - 40		North, east, south, and central Delta
Giant garter snake						0	
Aquatic	205	0	-	2:1[a]/ 3:1[b]	410 to 615		Northeast and Central Delta
Upland	570	67	-		1,140 to 1,710		
California tiger salamander	50	8	3:1	-	150	0	Byron Hills Region, East Contra Costa County
Mason's lilaeopsis	800 linear feet	0	-	1:1	0	800 linear feet	North, central, or west Delta

[11] Maximum direct impacts presented here do not include effects from restoration

5.4.1 Delta Smelt

5.4.1.1 Full Mitigation for Take of Delta Smelt

Incidental take of Delta smelt that may occur due to the PP is described in Section 4.1 *Delta Smelt*. That take may occur due to the following mechanisms:

1. Construction activities at the NDD, barge landings, HOR gate, and Clifton Court Forebay.

2. Loss of habitat and habitat connectivity due to construction at the NDD, barge landings, and HOR gate

3. Entrainment, impingement, and predation during operations at the NDD and the existing south Delta diversion facilities.

4. Reduced turbidity due to sediment withdrawal at the NDD.

5. Entrainment and impingement effects at the Suisun Marsh facilities and the North Bay Aqueduct.

Implementation of the take minimization measures (Section 5.3.1 *Delta Smelt*) will reduce take associated with construction activities (#1) to minimal levels that fall within the scope of uncertainty related to mitigation measures; thus, mitigation for construction-related habitat loss (#2) and operational take (#3, described below) also serves to provide full mitigation for take associated with construction activities. Entrainment and impingement take at the Suisun Marsh facilities and the North Bay Aqueduct (#5) are minimal and do not differ between the PP and the NAA; thus, mitigation previously committed to under the CDFG (2011) Delta Smelt consistency determination provides full mitigation for take due to these mechanisms.

NDD operations are expected to result in negligible entrainment, impingement, and predation of delta smelt. Combined with the reduction of such effects at south Delta, this impact will be fully mitigated through adherence to operations criteria including real-time operational adjustments.

Take that may occur due to reduced turbidity (#4) will be minimized, as described in Section 5.3.1.2.1 *Effects of Sediment Removal at the North Delta Diversions*, in two ways: (1) by reintroduction of sediment withdrawn at the NDD, in a manner to be determined jointly by DWR, Reclamation, CDFW, and USFWS, and (2) through operations that protect the initial pulses, which tend to carry greater sediment loads into the Delta. The analysis presented in Section 4.1 *Delta Smelt* does not demonstrate that this solution, or the reduced use of the south Delta facilities, will entirely avoid take by this mechanism. Any residual take that may result from reduced turbidity will be compensated by the habitat creation proposed to mitigate take due to habitat loss due to construction (#1). A portion of that mitigation, for ongoing operations of the south Delta facilities, is already included in the CEQA environmental baseline (see Table 1-2 *SWP Facilities and Activities Included and Not Included in the Proposed Project*) and consists of mitigation prescribed in the CDFG (2011) consistency determination. The remainder consists of shallow water habitat and tidal perennial habitat restoration identified in Table 5.4-1, and provides restoration of 347.7 acres of habitat suitable for Delta smelt, as detailed below.

5.4.1.2 Proposed Mitgation for Delta Smelt Take

The following mitigation is proposed for Delta smelt: Restoration of 347.7 acres of habitat suitable for Delta smelt, of which 102.7 acres is intended to offset construction impacts on Delta smelt and their habitat, and 245 acres are intended to offset potential impaired Delta smelt access to shallow water habitat in the vicinity of the NDDs (Table 5.4-1). Restoration will be performed at a site in the vicinity of Sherman Island, Cache Slough, or the north Delta to be approved by CDFW and USFWS. The proposed habitat restoration, shown in Table 5.4-1, will offset effects on Delta smelt spawning, rearing, and migration habitat. Of this total, the PP proposes to mitigate 245 acres of shallow water habitat for impacts related to the potential changes in access to shallow water habitat upstream of the proposed NDD. GIS was used to calculate that the total shallow water habitat located above the NDD (including both banks of the Sacramento River) is 250 acres. In addition to potential use of this habitat during the early part of the life cycle, Delta smelt may also use this habitat during spawning, which is believed to occur in sandy beach areas. Of the 250 acres of shallow water habitat located above the NDD, examination of aerial photographs combined with GIS analysis suggests that 36 acres are sandy beach area and therefore potentially suitable for spawning. This potential spawning area may become inaccessible to Delta smelt because of the presence of the NDD. Monitoring of Delta smelt use of this area will occur to evaluate whether this effect is occurring, and the mitigation for this impact may be altered if monitoring incorporated into the Section 7 and 2081(b) consultations determines that Delta smelt continue to use the area. Any such alteration would be subject to the review and approval of USFWS and CDFW. If it were to result in any increase in incidental take, or any reduction in mitigation needed to provide full mitigation for approved take, such alteration would require a new or amended incidental take permit.

Habitat restoration site selection and design will occur in coordination with CDFW, USFWS and NMFS. Restoration will primarily occur through breaching or setback of levees, thereby restoring tidal fluctuation to land parcels currently isolated behind those levees. Factors to be considered when evaluating sites for potential location and design of habitat restoration include the potential to create desirable habitat features, as summarized by Sommer and Mejia (2013) in their suggestions for pilot Delta smelt restoration projects: low salinity (< 6 ppt); moderate temperature (7–25°C); high turbidity (>12 NTU); sand-dominated substrate; at least moderately tidal; high copepod density; low submerged aquatic vegetation (SAV); low *Microcystis*; and open water habitat adjacent to long residence time habitat. These factors are similar to those considered in terms of crediting restoration sites in the Delta:

- Improved rearing habitat: High order, marsh-adjacent channels; energetic; turbid, cool, low salinity water over a diverse landscape for capturing prey and decreased predation; accessible to Delta smelt for direct use.

- Improved spawning habitat: Sandy beaches with appropriate water velocities and depths to maintain the habitat and is accessible to Delta smelt for direct use. Must have appropriate water quality conditions for Delta smelt.

Geographic priority will be given to sites in the vicinity of Sherman Island, Cache Slough, and the North Delta. Tidal perennial habitat restoration will replace loss of such habitat at barge

landings and the HOR gate, whereas shallow water habitat restoration will replace loss of such habitat in the north Delta as a result of NDD construction and operations.

Shallow subtidal areas in large portions of the Delta support extensive beds of nonnative SAV that adversely affect listed species of fish (Nobriga et al. 2005; Brown and Michniuk 2007; Grimaldo et al. 2012). In other portions of the Delta, shallow subtidal areas provide suitable habitat for native species, such as Delta smelt in the Liberty Island/Cache Slough area, and do not promote the growth of nonnative SAV (Nobriga et al. 2005; McLain and Castillo 2009). Shallow water and tidal perennial habitat restoration is not intended to restore large areas of shallow subtidal aquatic habitat, which would collaterally create habitat for nonnative predators; rather, shallow subtidal aquatic habitat restoration is proposed in association with tidal habitat, which will provide more heterogeneity and support pelagic habitat adjacent to emergent wetland. Tidal perennial habitat restoration will be sited in the vicinity of Sherman Island, Cache Slough, or at other sites in the north Delta.

Where practicable and appropriate, portions of restoration sites will be raised to elevations that will support tidal marsh vegetation following levee breaching. Depending on the degree of subsidence and location, lands may be elevated by grading higher elevations to fill subsided areas, importing clean dredged or fill material from other locations, or planting tules or other appropriate vegetation to raise elevations in shallowly subsided areas over time through organic material accumulation (Ingebritsen et al. 2000). Surface grading will create a shallow elevation gradient from the marsh plain to the upland transition habitat. Based on assessments of local hydrodynamic conditions, sediment transport, and topography, restoration activities may be designed and implemented in a manner that accelerates the development of tidal channels within restored marsh plains. Following reintroduction of tidal exchange, tidal marsh vegetation is expected to establish and maintain itself naturally at suitable elevations relative to the tidal range. Depending on site-specific conditions and monitoring results, patches of native emergent vegetation may be planted to accelerate the establishment of native marsh vegetation on restored marsh plain surfaces. A conceptual illustration of restored tidal perennial habitat is presented in Figure 5-1.

A technical team consisting of representatives from Reclamation, NMFS, USFWS, DWR and CDFW will be established to develop siting, design, and performance criteria for tidal perennial habitat restoration. This group will work collaboratively to select the most biologically appropriate and cost-effective restoration site(s), design the restoration plan, set performance criteria, and develop the restoration unit management plan for the site(s).

Completion of construction at each site will precede the corresponding impacts associated with conveyance facility construction. Full compliance with the mitigation measures in this Application will be based on performance of the completed site consistent with the success criteria stated in the site-specific design documents, as demonstrated in reports to be provided to CDFW, USFWS and NMFS by Reclamation and DWR.

General AMMs described in Appendix 3.F *General Avoidance and Minimization Measures* will be implemented during tidal restoration construction. General AMMs applicable to tidal restoration work include AMMs 1 to 10, AMM14, AMM15, and AMM17.

Construction of shallow water and tidal perennial habitat restoration could affect Delta smelt by potential spills of construction equipment fluids; increased turbidity; increased exposure to methylmercury, pesticides and other contaminants when upland soils are inundated; and increased exposure to contaminants from disturbed aquatic sediments. However, these effects will be temporary and will be offset by the long-term benefits of the restored habitat (any sites so contaminated as to produce contrary results will be deemed unsuitable for restoration).

Actions to be taken during restoration are expected to include pre-breach management of the restoration site to promote desirable vegetation and elevations within the restoration area and levee maintenance, improvement, or redesign. This may require substantial earthwork outside but adjacent to tidal and other aquatic environments. Levee breaching will require removing levee materials from within and adjacent to tidal and other aquatic habitats. Levee breaching will entail in-water work using construction equipment such as bulldozers and backhoes; any in-water work will be performed during an in-water work window to be approved by CDFW, NMFS and USFWS. Removed levee materials will be placed on the remaining levee sections, placed within the restoration area, or hauled to a disposal area previously approved by CDFW, NMFS and USFWS. Construction at tidal habitat restoration sites is expected to involve the following activities.

- Excavating channels to encourage the development of sinuous, high-density dendritic channel networks within restored marsh plain.
- Modifying ditches, cuts, and levees to encourage more natural tidal circulation and better flood conveyance based on local hydrology.
- Removal or breaching of existing levees or embankments or creation of new structures to allow restoration to take place while protecting adjacent land.
- Prior to breaching, recontouring the surface to maximize the extent of surface elevation suitable for establishment of tidal marsh vegetation by scalping higher elevation land to provide fill for placement on subsided lands to raise surface elevations.
- Prior to breaching, importing dredge or fill material and placing it in shallowly subsided areas to raise ground surface elevations to a level suitable for establishment of tidal marsh vegetation.
- Tidal habitat restored adjacent to farmed lands may require construction of dikes to maintain those land uses.

5.4.2 Longfin Smelt

5.4.2.1 Full Mitigation for Take of Longfin Smelt

Incidental take of longfin smelt that may occur due to the PP is described in Section 4.2 *Longfin Smelt*. That take may occur due to the following mechanisms:

1. Construction activities at the NDD, barge landings, HOR gate, and Clifton Court Forebay.

2. Loss of habitat and habitat connectivity due to construction at the NDD, barge landings, and HOR gate

3. Entrainment, impingement, and predation during operations at the NDD and the existing south Delta diversion facilities.

4. Reduced turbidity due to sediment withdrawal at the NDD.

5. Entrainment and impingement effects at the Suisun Marsh facilities and the North Bay Aqueduct.

Implementation of the take minimization measures (Section 5.3.2 *Longfin Smelt*) will reduce take associated with construction activities (#1) to minimal levels that fall within the scope of uncertainty related to mitigation measures; thus, mitigation for construction-related habitat loss (#2) and operational take (#3, described below) also serves to provide full mitigation for take associated with construction activities. Entrainment and impingement take at the Suisun Marsh facilities and the North Bay Aqueduct (#5) are minimal and do not differ between the PP and the NAA; thus, mitigation committed to under the CDFG (2009) incidental take permit provides full mitigation for take due to these mechanisms.

Take associated with entrainment, impingement, and predation during operations at the NDD will be minimized through operations criteria, including real-time operational adjustments. Take associated with the existing south Delta diversion facilities (#3) has been mitigated through mitigation prescribed in the CDFG (2009) incidental take permit. The NDD is expected to have negligible entrainment, impingement, and predation of longfin smelt. Combined with the reduction of such effects at south Delta, this impact will be fully mitigated through adherence to operations criteria.

Take that may occur due to reduced turbidity (#4) will be minimized, as described in Section 5.3.2.3.2 *Effects of Sediment Removal at the North Delta Diversions*, in two ways: (1) by reintroduction of sediment withdrawn at the NDD, in a manner to be determined jointly by DWR, Reclamation, CDFW, and USFWS, and (2) through operations that protect the initial pulses, which tend to carry greater sediment loads into the Delta. The analysis presented in Section 4.2 *Longfin Smelt* does not demonstrate that this solution, or the reduced use of the south Delta facilities, will entirely avoid take by this mechanism. Any residual take that may result from reduced turbidity will be compensated by the habitat creation proposed to mitigate take due to habitat loss due to construction (#1). This consists of shallow water habitat and tidal perennial habitat restoration identified in Table 5.4-1, and provides restoration of 347.7 acres of habitat suitable for longfin smelt, as detailed below.

5.4.2.2 Proposed Mitigation for Longfin Smelt Take

The following mitigation is proposed for longfin smelt: Restoration of 347.7 acres of habitat suitable for longfin smelt, of which 102.7 acres is intended to offset construction impacts on longfin smelt and their habitat, and 245 acres are intended to offset potential impaired longfin smelt access to shallow water habitat in the vicinity of the NDDs (Table 5.4-1). Restoration will be performed at a site in the vicinity of Sherman Island, Cache Slough, or the north Delta to be approved by CDFW and USFWS. The proposed habitat restoration, shown in Table 5.4-1, will

offset effects on longfin smelt spawning, rearing, and migration habitat. Of this total, the PP proposes to mitigate 245 acres of shallow water habitat for impacts related to the potential changes in access to shallow water habitat upstream of the proposed NDD. GIS was used to calculate that the total shallow water habitat located above the NDD (including both banks of the Sacramento River) at 250 acres. In addition to potential use of this habitat during the early part of the life cycle, longfin smelt may also use this habitat during spawning, which is believed to occur in sandy beach areas. Of the 250 acres of shallow water habitat located above the NDD, examination of aerial photographs combined with GIS analysis suggests that 36 acres are sandy beach area and therefore potentially suitable for spawning. This potential spawning area may become inaccessible to longfin smelt because of the presence of the NDD. Monitoring of longfin smelt use of this area will occur to evaluate whether this effect is occurring, and the mitigation for this impact may be altered if monitoring incorporated into the Section 7 consultation determines that longfin smelt continue to use the area. Any such alteration would be subject to the review and approval of USFWS and CDFW. If it were to result in any increase in incidental take, or any reduction in mitigation needed to provide full mitigation for approved take, such alteration would require a new or amended incidental take permit.

Habitat restoration site selection and design will occur in coordination with CDFW, USFWS and NMFS. Restoration will primarily occur through breaching or setback of levees, thereby restoring tidal fluctuation to land parcels currently isolated behind those levees. Factors to be considered when evaluating sites for potential location and design of habitat restoration include the potential to create desirable habitat features, as summarized by Sommer and Mejia (2013) in their suggestions for pilot Delta Smelt restoration projects: low salinity (< 6 ppt); moderate temperature (7–25°C); high turbidity (>12 NTU); sand-dominated substrate; at least moderately tidal; high copepod density; low submerged aquatic vegetation (SAV); low *Microcystis*; and open water habitat adjacent to long residence time habitat. These factors are similar to those considered in terms of crediting restoration sites in the Delta:

- Improved rearing habitat: High order, marsh-adjacent channels; energetic; turbid, cool, low salinity water over a diverse landscape for capturing prey and decreased predation; accessible to longfin smelt for direct use.

- Improved spawning habitat: Sandy beaches with appropriate water velocities and depths to maintain the habitat and is accessible to longfin smelt for direct use. Must have appropriate water quality conditions for longfin smelt.

Although these restored habitat features are focused on Delta smelt at various life stages, they are likely to be appropriate for longfin smelt, given the location of the habitat effects that are being mitigated (i.e., relatively far upstream in terms of the species' range)[12]. Geographic priority will be given to sites in the vicinity of Sherman Island, Cache Slough, and the North Delta. Tidal perennial habitat restoration will replace loss of such habitat at barge landings and the HOR gate, whereas shallow water habitat restoration will replace loss of such habitat in the north Delta as a result of NDD construction and operations.

[12] It is acknowledged that habitat restoration for longfin smelt in the SWP/CVP 2009 ITP was required to be mesohaline (i.e., 5-18 ppt salinity), but provision of habitat within oligohaline water (0.5-5 ppt) for Delta smelt would also function to provide mitigation for longfin smelt.

Shallow subtidal areas in large portions of the Delta support extensive beds of nonnative SAV that adversely affect listed species of fish (Nobriga et al. 2005; Brown and Michniuk 2007; Grimaldo et al. 2012). In other portions of the Delta, shallow subtidal areas provide suitable habitat for native species such as longfin smelt in the Liberty Island/Cache Slough area, and do not promote the growth of nonnative SAV (Nobriga et al. 2005; McLain and Castillo 2009). Shallow water and tidal perennial habitat restoration is not intended to restore large areas of shallow subtidal aquatic habitat, which would collaterally create habitat for nonnative predators; rather, shallow subtidal aquatic habitat restoration is proposed in association with tidal habitat, which will provide more heterogeneity and support pelagic habitat adjacent to emergent wetland. Tidal perennial habitat restoration will be sited in the vicinity of Sherman Island, Cache Slough, or at other sites in the north Delta.

Where practicable and appropriate, portions of restoration sites will be raised to elevations that will support tidal marsh vegetation following levee breaching. Depending on the degree of subsidence and location, lands may be elevated by grading higher elevations to fill subsided areas, importing clean dredged or fill material from other locations, or planting tules or other appropriate vegetation to raise elevations in shallowly subsided areas over time through organic material accumulation (Ingebritsen et al. 2000). Surface grading will create a shallow elevation gradient from the marsh plain to the upland transition habitat. Based on assessments of local hydrodynamic conditions, sediment transport, and topography, restoration activities may be designed and implemented in a manner that accelerates the development of tidal channels within restored marsh plains. Following reintroduction of tidal exchange, tidal marsh vegetation is expected to establish and maintain itself naturally at suitable elevations relative to the tidal range. Depending on site-specific conditions and monitoring results, patches of native emergent vegetation may be planted to accelerate the establishment of native marsh vegetation on restored marsh plain surfaces. A conceptual illustration of restored tidal perennial habitat is presented in Figure 5-1.

A technical team consisting of representatives from Reclamation, NMFS, USFWS, DWR and CDFW will be established to develop siting, design, and performance criteria for tidal perennial habitat restoration. This group will work collaboratively to select the most biologically appropriate and cost-effective restoration site(s), design the restoration plan, set performance criteria, and develop the restoration unit management plan for the site(s).

Completion of construction at each site will precede the corresponding impacts associated with conveyance facility construction. Full compliance with the mitigation measures in this Application will be based on performance of the completed site consistent with the success criteria stated in the site-specific design documents, as demonstrated in reports to be provided to CDFW, USFWS and NMFS by Reclamation and DWR.

General AMMs described in Appendix 3.F *General Avoidance and Minimization Measures* will be implemented during tidal restoration construction. General AMMs applicable to tidal restoration work include AMMs 1 to 10, AMM14, AMM15, and AMM17.

Construction of shallow water and tidal perennial habitat restoration could affect longfin smelt by potential spills of construction equipment fluids; increased turbidity; increased exposure to methylmercury, pesticides and other contaminants when upland soils are inundated; and

increased exposure to contaminants from disturbed aquatic sediments. However, these effects will be temporary and will be offset by the long-term benefits of the restored habitat (any sites so contaminated as to produce contrary results will be deemed unsuitable for restoration).

Actions to be taken during restoration are expected to include pre-breach management of the restoration site to promote desirable vegetation and elevations within the restoration area and levee maintenance, improvement, or redesign. This may require substantial earthwork outside but adjacent to tidal and other aquatic environments. Levee breaching will require removing levee materials from within and adjacent to tidal and other aquatic habitats. Levee breaching will entail in-water work using construction equipment such as bulldozers and backhoes; any in-water work will be performed during an in-water work window to be approved by CDFW, NMFS and USFWS. Removed levee materials will be placed on the remaining levee sections, placed within the restoration area, or hauled to a disposal area previously approved by CDFW, NMFS and USFWS. Construction at tidal habitat restoration sites is expected to involve the following activities.

- Excavating channels to encourage the development of sinuous, high-density dendritic channel networks within restored marsh plain.
- Modifying ditches, cuts, and levees to encourage more natural tidal circulation and better flood conveyance based on local hydrology.
- Removal or breaching of existing levees or embankments or creation of new structures to allow restoration to take place while protecting adjacent land.
- Prior to breaching, recontouring the surface to maximize the extent of surface elevation suitable for establishment of tidal marsh vegetation by scalping higher elevation land to provide fill for placement on subsided lands to raise surface elevations.
- Prior to breaching, importing dredge or fill material and placing it in shallowly subsided areas to raise ground surface elevations to a level suitable for establishment of tidal marsh vegetation.
- Tidal habitat restored adjacent to farmed lands may require construction of dikes to maintain those land uses.

5.4.3 Sacramento River Winter-Run Chinook Salmon

5.4.3.1 Full Mitigation for Take of Winter-Run Chinook Salmon

Incidental take of winter-run Chinook salmon that may occur due to the PP is described in Section 4.3 *Sacramento River Winter-Run Chinook Salmon*. That take may occur due to the following mechanisms:

1. Geotechnical exploration
2. Construction activities at the NDD, barge landings, HOR gate, and Clifton Court Forebay.

3. Loss of habitat and habitat connectivity due to construction at the NDD, barge landings, and HOR gate

4. Entrainment[13], impingement, and predation during operations at the NDD and the existing south Delta diversion facilities.

5. Entrainment and impingement effects at the Suisun Marsh facilities and the North Bay Aqueduct.

6. Far-field hydrodynamic effects such as increased travel time and greater entry into the interior Delta through Georgiana Slough, with resulting increased risk of predation.

7. Blockage of upstream passage by the Delta Cross Channel gates.

Implementation of the take minimization measures (Section 5.3.3 *Sacramento River Winter-Run Chinook Salmon*) will reduce take associated with geotechnical exploration (#1) and construction activities (#2) to minimal levels that fall within the scope of uncertainty related to mitigation measures; thus, mitigation for construction-related habitat loss and operational take (#3 and #4, described below) also serves to provide full mitigation for take due to construction activities. Entrainment and impingement take at the Suisun Marsh facilities and the North Bay Aqueduct (#5) are minimal and do not differ between the PP and the NAA; thus, mitigation committed to under the CDFG (2012) consistency determination provides full mitigation for take due to these mechanisms. The extent to which blockage of passage by the Delta Cross Channel gates (#7) would result in take is uncertain, given that the extent to which adult winter-run Chinook salmon could find an alternative pathway through the Delta, or how long they may hold below the gates until they are reopened; the modeled differences in gate closures under the PP were not similar to NAA, so mitigation prescribed pursuant to the CDFG (2012) consistency determination addresses this take.

Entrainment, impingement, predation, and far-field effects (#6) resulting from operations at the NDD will be mitigated in large part through the operational criteria and the real-time operations included in the PP, and in particular through transitional operational criteria, which will be used to minimize these sources of take by reducing export rates. The objective is to use these operational means to minimize take to the point where, taken in consideration with other mitigation proposed for the species, the full mitigation standard is met. Operational criteria and real-time operations, combined with the screen design on the intakes, constitute the principal means of minimizing salmonid take through the NDD reach and is subject to monitoring (to validate survivorship rates through the NDD reach) and adaptive management (to review and revise the operational and transitional criteria as needed to ensure that the 95 percent survivorship target [Section 3.3.2.1 *Operational Criteria for North Delta CVP/SWP Export Facilities*] is met). This will occur via the monitoring and adaptive management processes described in Chapter 6 *Monitoring Plan*, although the monitoring protocols to be used are still being developed by CDFW and NMFS staff. The nonphysical barrier at Georgiana Slough will also provide mitigation for the above-noted effects of the NDD. Entrainment and predation

[13] Entrainment is unlikely at the NDD because of the typical size of juvenile winter-run Chinook salmon when they enter the Delta.

resulting from operations at the south Delta export facilities (#4) will also be minimized through the operational criteria and real-time operations included in the PP.

Habitat-based mitigation is proposed to mitigate take due to loss of habitat and habitat connectivity (#3), and due to entrainment, impingement, and predation resulting from operations at the NDD. This consists of channel margin habitat creation and tidal perennial habitat creation, identified in Table 5.4-1. Of that, mitigation for loss of habitat and habitat connectivity (#3) consists of creating 154.8 acres of tidal perennial habitat and 3.04 linear miles of channel margin habitat suitable for winter-run Chinook salmon, as detailed below. Another 1.26 linear miles of channel margin habitat creation is designated as mitigation for operational take (#3) of restored riparian bench habitat impacted by NDD operations. Habitat-based mitigation for the existing south Delta diversion facilities (#4) is already included in the environmental baseline (see Table 1-2 *SWP Facilities and Activities Included and Not Included in the Proposed Project*), and consists of mitigation described in the CDFG (2012) consistency determination.

5.4.3.2 Tidal Perennial Habitat Restoration

The PP includes 154.8 acres of tidal perennial habitat restoration to offset effects on Chinook salmon rearing and migration habitat, as shown in Table 5.4-1. Tidal perennial habitat restoration site selection and design will occur in coordination with CDFW, USFWS and NMFS. Restoration will primarily occur through breaching or setback of levees, thereby restoring tidal fluctuation to land parcels currently isolated behind those levees. Factors to be considered when evaluating sites for potential location and design of tidal perennial habitat restoration include the potential to create small (1st and 2nd order) dendritic tidal channels (channels that end in the upper marsh) for rearing (Fresh 2006); tidal freshwater sloughs with rich production of such insects as chironomid (midge) larvae; brackish marshes with emergent vegetation providing insect larvae, mysids, and epibenthic amphipods; and open-water habitats with drifting insects, zooplankton such as crab larvae, pelagic copepods, and larval fish (Quinn 2005).

Shallow subtidal areas in large portions of the Delta support extensive beds of nonnative SAV that adversely affect listed species of fish (Nobriga et al. 2005; Brown and Michniuk 2007; Grimaldo et al. 2012). In other portions of the Delta, shallow subtidal areas provide suitable habitat for native species, such as Delta Smelt in the Liberty Island/Cache Slough area, and do not promote the growth of nonnative SAV (Nobriga et al. 2005; McLain and Castillo 2009). Tidal perennial habitat restoration is not intended to restore large areas of shallow subtidal aquatic habitat, which would collaterally create habitat for nonnative predators; rather, shallow subtidal aquatic habitat restoration is proposed in association with tidal habitat, which will provide more heterogeneity and support pelagic habitat adjacent to emergent wetland. Additionally, bench habitats will be incorporated into site selection and design to provide added specific benefits to salmonids, such as shallow-water foraging and refuge habitat. Tidal perennial habitat restoration will be sited in consultation with NMFS, USFWS, and CDFW, within areas of the Delta appropriate for offsetting effects of the PP.

Where practicable and appropriate, portions of restoration sites will be raised to elevations that will support tidal marsh vegetation following levee breaching. Depending on the degree of subsidence and location, lands may be elevated by grading higher elevations to fill subsided areas, importing clean dredged or fill material from other locations, or planting tules or other

appropriate vegetation to raise elevations in shallowly subsided areas over time through organic material accumulation (Ingebritsen et al. 2000). Surface grading will create a shallow elevation gradient from the marsh plain to the upland transition habitat. Based on assessments of local hydrodynamic conditions, sediment transport, and topography, restoration activities may be designed and implemented in a manner that accelerates the development of tidal channels within restored marsh plains. Following reintroduction of tidal exchange, tidal marsh vegetation is expected to establish and maintain itself naturally at suitable elevations relative to the tidal range. Depending on site-specific conditions and monitoring results, patches of native emergent vegetation may be planted to accelerate the establishment of native marsh vegetation on restored marsh plain surfaces. A conceptual illustration of restored tidal perennial habitat is presented in Figure 5-1.

A technical team consisting of representatives from Reclamation, NMFS, USFWS, DWR and CDFW will be established to develop siting, design, and performance criteria for tidal perennial habitat restoration. This group will work collaboratively to select the most biologically appropriate and cost-effective restoration site(s), design the restoration plan, set performance criteria, and develop the restoration unit management plan for the site(s).

Completion of construction at each site will precede the corresponding impacts associated with conveyance facility construction. Full compliance with the mitigation measures in this Application will be based on performance of the completed site consistent with the success criteria stated in the site-specific design documents, as demonstrated in reports to be provided to CDFW, USFWS and NMFS by DWR and Reclamation.

General TMMs described in Appendix 3.F *General Avoidance and Minimization Measures* will be implemented during tidal restoration construction. General TMMs applicable to tidal restoration work include AMMs 1 to 10, AMM14, AMM15, and AMM17.

Construction of tidal perennial habitat restoration could affect Chinook salmon by potential spills of construction equipment fluids; increased turbidity; increased exposure to methylmercury, pesticides and other contaminants when upland soils are inundated; and increased exposure to contaminants from disturbed aquatic sediments. However, these effects will be temporary and will be offset by the long-term benefits of the restored habitat (any sites so contaminated as to produce contrary results will be deemed unsuitable for restoration).

Actions to be taken during restoration are expected to include pre-breach management of the restoration site to promote desirable vegetation and elevations within the restoration area and levee maintenance, improvement, or redesign. This may require substantial earthwork outside but adjacent to tidal and other aquatic environments. Levee breaching will require removing levee materials from within and adjacent to tidal and other aquatic habitats. Levee breaching will entail in-water work using construction equipment such as bulldozers and backhoes; any in-water work will be performed during an in-water work window to be approved by CDFW, NMFS and USFWS. Removed levee materials will be placed on the remaining levee sections, placed within the restoration area, or hauled to a disposal area previously approved by CDFW, NMFS and USFWS. Construction at tidal habitat restoration sites is expected to involve the following activities.

- Excavating channels to encourage the development of sinuous, high-density dendritic channel networks within restored marsh plain.

- Modifying ditches, cuts, and levees to encourage more natural tidal circulation and better flood conveyance based on local hydrology.

- Removal or breaching of existing levees or embankments or creation of new structures to allow restoration to take place while protecting adjacent land.

- Prior to breaching, recontouring the surface to maximize the extent of surface elevation suitable for establishment of tidal marsh vegetation by scalping higher elevation land to provide fill for placement on subsided lands to raise surface elevations.

- Prior to breaching, importing dredge or fill material and placing it in shallowly subsided areas to raise ground surface elevations to a level suitable for establishment of tidal marsh vegetation.

- Tidal habitat restored adjacent to farmed lands may require construction of dikes to maintain those land uses.

5.4.3.3 Channel Margin Habitat Restoration

The PP includes 4.3 linear miles of channel margin restoration to offset effects on Chinook salmon rearing and migration habitat caused by the reduction in frequency of inundation of existing restored benches and habitat loss due to the NDD. The proposed compensation is based on GIS analysis of the permanent and temporary footprint for the NDD, and a review of the magnitude of change for the select benches in the analysis. GIS was used to determine the acreage of effect for each structure, including areas located in habitat that could be affected by placement of permanent in-water structures as well as the temporary areas of effect. The construction-related portion reflects the footprint of the combined three NDD (5,367 linear feet, or 1.02 miles), including their association wing wall transitions. The operations-related portion reflects potentially less frequent inundation of riparian benches because of NDD water diversions. The total linear extent of riparian bench effects (2,212 feet, or 0.42 miles) was derived as follows, based on the greatest differences between NAA and PP from the analysis presented in Section 4.3.4.1.2.2.2.1 *Bench Inundation*:

- 29% lower riparian bench inundation index under PP in the Sacramento River from Sutter Steamboat sloughs to Rio Vista (1,685 feet of bench): 0.29 × 1,685 = 489 feet;

- 24% lower riparian bench inundation index under PP in the Sacramento River below the NDD to Sutter/Steamboat sloughs (3,037 feet of bench): 0.24 × 3,037 = 729 feet;

- 19% lower riparian bench inundation index under PP in Sutter/Steamboat Sloughs (5,235 feet of bench): 0.19 × 5,235 = 995 feet.

Channel margin restoration will be accomplished by improving channel geometry and restoring riparian, marsh, and mudflat habitats on the water side of levees along channels that provide

rearing and outmigration habitat for juvenile salmonids, similar to what is currently done by the USACE and others when implementing levee improvements. Channel margin enhancements associated with federal project levees will not be implemented on the levee, but rather on benches to the waterward side of such levees, and flood conveyance will be maintained as designed. Channel margin enhancements associated with federal project levees may require permission from USACE in accordance with USACE's authority under the Rivers and Harbors Act (33 USC Section 408) and USACE levee vegetation policy. Accordingly, sites for the channel margin enhancements have not yet been determined, but they will be sited within the action area at locations along the Sacramento River, Steamboat and Sutter Sloughs, or in other areas subject to approval by NMFS and CDFW. On behalf of the State of California, DWR and the Central Valley Flood Protection Board are in coordination with USACE to minimize issues and identify a pathway for compliance. Any such enhancements will be designed, constructed, and maintained to ensure no reduction in performance of the federal flood project. Linear miles of enhancement will be measured along one side of a given channel segment (e.g., if both sides of a channel were enhanced for a length of 1 mile, this would account for a total of 2 miles of channel margin enhancement).

Chinook salmon use channel margin habitat for rearing and protection from predators, and the primary purpose of channel margin enhancement is to offset shoreline effects caused by permanent habitat removal. Vegetation along channel margins contributes woody material, both instream and on channel banks, which increases instream cover for fish. Channel margin habitat is expected to provide rearing habitat and improve conditions along important migration corridors by providing increased habitat complexity, overhead and in-water cover, and prey resources for listed species of fish. Channel margin enhancement is intended to increase habitat diversity and complexity, provide long-term nutrient storage and substrate for aquatic macroinvertebrates, moderate flow disturbances, increase retention of leaf litter, and provide refuge for fish during high flows. Channel margin enhancement is expected to increase rearing habitat for Chinook salmon fry in particular, through enhancement and creation of additional shallow-water habitat that will provide foraging opportunities and refuge from unfavorable hydraulic conditions and predation.

Channel margin enhancement will be achieved by implementing site-specific projects. The following habitat suitability factors will be considered when evaluating sites for potential location and design of enhanced channel margins.

- Existing poor habitat quality and biological performance for listed species of fish combined with extensive occurrence of listed species of fish.
- Locations where migrating salmon are likely to require rest during high flows.
- The length of channel margin that can be practicably enhanced and the distance between enhanced areas (there may be a tradeoff between enhancing multiple shorter reaches that have less distance between them and enhancing relatively few longer reaches with greater distances between them).

- The potential for native riparian plantings to augment breeding and foraging habitat for listed species using riparian habitat, such as Swainson's hawk and tricolored blackbird, in proximity to known occurrences.

- The potential cross-sectional profile of enhanced channels (elevation of habitat, topographic diversity, width, variability in edge and bench surfaces, depth, and slope).

- The potential amount and distribution of installed woody debris along enhanced channel margins.

- The extent of shaded riverine aquatic overstory and understory vegetative cover needed to provide future input of large woody debris.

A technical team consisting of representatives from Reclamation, NMFS, USFWS, DWR and CDFW will be established to develop siting, design, and performance criteria for channel margin restoration. This group will work collaboratively to select the most biologically appropriate and cost-effective restoration site(s), design the restoration plan, set performance criteria, and develop the restoration unit management plan for the site(s).

Prior to channel margin enhancement construction (the on-the-ground activities that will put the channel margin enhancements in place) for each project, preparatory actions will include interagency coordination, feasibility evaluations, site acquisition, development of site-specific plans, and environmental compliance. Completion of construction at each site will precede the corresponding impacts associated with conveyance facility construction, but full compliance with the mitigation measures in this Application will be based on performance of the completed site consistent with the success criteria stated in the site-specific design documents, as demonstrated in reports to be provided to CDFW, USFWS and NMFS by Reclamation.

General TMMs described in Appendix 3.F, *General Avoidance and Minimization Measures* will be implemented, and an in-water work windows subject to approval by CDFW, USFWS and NMFS will be observed, during implementation of channel margin enhancement. General AMMs applicable to channel margin enhancement work include AMMs 1 to 10, AMM14, AMM15, and AMM17. After construction, each project will be monitored and adaptively managed to ensure that the success criteria outlined in the site-specific restoration plan are met.

Channel margin enhancement actions are expected to be performed in the following manner.

- Use large mechanized equipment (typically, a trackhoe) to remove riprap from channel margins.

- Use grading equipment such as trackhoes and bulldozers to modify the channel margin side of levees or setback levees to create low floodplain benches with variable surface elevations that create hydrodynamic complexity and support emergent vegetation.

- Use construction equipment such as trackhoes, bulldozers and cranes to install large woody material (e.g., tree trunks and stumps) into constructed low benches or into existing riprapped levees to provide physical complexity.

- Use personnel and small powered equipment such as off-road vehicles (ORV) to plant riparian and emergent wetland vegetation on created benches.

5.4.3.4 South Delta Habitat Restoration

The PP includes construction in the central and south Delta of the HOR gate and several barge landings. This construction will convert areas that are considered aquatic habitat for salmon into physical structures that commonly attract predatory fish and may reduce habitat complexity for native fishes. The affected habitat largely consists of rip-rap, and effects on this habitat will be offset by the restoration shown, for each listed species, in Table 5.4-1. Mitigation proposed as part of the PP includes restoration actions that will offset, at a 3:1 ratio, any habitat impacts that may occur due to HOR gate and barge landing construction. The PP's restoration actions will adhere to the following principles, which assure that the proposed habitat restoration benefits Chinook salmon.

- Habitat restoration and mitigation efforts will target migration routes commonly used by San Joaquin River basin (i.e., spring-run Chinook salmon) to the extent possible. Highest priority for restoration site selection will apply to sites near the south Delta construction sites. Sites upstream of the head of Old River will also be considered if those locations provide greater benefit.

- The restoration will focus on creating benefits for Chinook salmon through improved habitat function. Per note 2 in Table 5.4-1, some combination of channel margin and tidal perennial habitat, sited and designed in coordination with NMFS, USFWS and CDFW, may be targeted to achieve these benefits, consistent with restoring south Delta historical habitat function and processes (as defined by Whipple et al. 2012). Habitat functions most beneficial to Chinook salmon and other native species will therefore be the focus on the restoration mitigation efforts. Examples include restoration of floodplain habitat, riparian habitat with appropriate vegetation to deliver organic inputs and terrestrial invertebrates to the adjacent riverine system, refugia from predators or elevated velocities resulting from high flows, and seasonal flooding during winter and spring even in drier water year types.

- As part of the restoration of tidal perennial and/or channel margin habitat restoration, features may include small-scale levee setbacks or benches that provide seasonally inundated terraces during high runoff events. Restoration plans will consider areas where this functionality can be restored or created. An Engineer Technical Letter variance will need to be obtained from the Corps of Engineers, and may limit the areas that can be restored.

- Restoration areas will promote benefits for native species and deterrents to non-native species. For instance, seasonal flooding and draining with varying inundation periods are a natural deterrent to colonization of invasive plants and species. Vegetation on the created terraces or floodplains will be monitored for invasive plant species. Control of invasive plants will be performed in a manner to be determined in consultation with the resource agencies to avoid infestations.

5.4.4 Central Valley Spring-Run Chinook Salmon

5.4.4.1 Full Mitigation for Take of Spring-Run Chinook Salmon

Incidental take of spring-run Chinook salmon that may occur due to the PP is described in Section 4.4 *Central Valley Spring-Run Chinook Salmon*. That take may occur due to the following mechanisms:

1. Geotechnical exploration
2. Construction activities at the NDD, barge landings, HOR gate, and Clifton Court Forebay.
3. Loss of habitat and habitat connectivity due to construction at the NDD, barge landings, and HOR gate
4. Entrainment[14], impingement, and predation during operations at the NDD and the existing south Delta diversion facilities.
5. Entrainment and impingement effects at the Suisun Marsh facilities and the North Bay Aqueduct.
6. Far-field hydrodynamic effects such as increased travel time and greater entry into the interior Delta through Georgiana Slough, with resulting increased risk of predation.
7. Blockage of upstream passage by the Delta Cross Channel gates.

Implementation of the take minimization measures (Section 5.4.3 *Central Valley Spring-Run Chinook Salmon*) will reduce take associated with geotechnical exploration (#1) and construction activities (#2) to minimal levels that fall within the scope of uncertainty related to mitigation measures; thus, mitigation for construction-related habitat loss and operational take (#3 and #4, described below) also serves to provide full mitigation for take due to construction activities. Entrainment and impingement take at the Suisun Marsh facilities and the North Bay Aqueduct (#5) are minimal and do not differ between the PP and the NAA; thus, mitigation committed to under the CDFG (2012) consistency determination provides full mitigation for take due to these mechanisms. The extent to which blockage of passage by the Delta Cross Channel gates (#7) would result in take is uncertain, given that the extent to which adult spring-run Chinook salmon could find an alternative pathway through the Delta, or how long they may hold below the gates until they are reopened; the modeled differences in gate closures under the PP were not similar to NAA, so mitigation described in the CDFG (2012) consistency determination addresses this take.

Entrainment, impingement, predation, and far-field effects (#6) resulting from operations at the NDD will be mitigated in large part through the operational criteria and the real-time operations included in the PP, and in particular through transitional operational criteria, which will be used to minimize these sources of take by reducing export rates. The objective is to use these

[14] Entrainment is unlikely at the NDD because of the typical size of juvenile winter-run Chinook salmon when they enter the Delta.

operational means to minimize take to the point where, taken in consideration with other mitigation proposed for the species, the full mitigation standard is met. Operational criteria and real-time operations, combined with the screen design on the intakes, constitute the principal means of minimizing salmonid take through the NDD reach and is subject to monitoring (to validate survivorship rates through the NDD reach) and adaptive management (to review and revise the operational and transitional criteria as needed to ensure that the 95 percent survivorship target [Section 3.3.2.1 *Operational Criteria for North Delta CVP/SWP Export Facilities*] is met). This will occur via the monitoring and adaptive management processes described in Chapter 6 *Monitoring Plan*, although the monitoring protocols to be used are still being developed by CDFW and NMFS staff. The nonphysical barrier at Georgiana Slough will also provide mitigation for the above-noted effects of the NDD. Entrainment and predation resulting from operations at the south Delta export facilities (#4) will also be minimized through the operational criteria and real-time operations included in the PP.

Habitat-based mitigation is proposed to mitigate take due to loss of habitat and habitat connectivity (#3), and due to entrainment, impingement, and predation resulting from operations at the NDD. This consists of channel margin habitat creation and tidal perennial habitat creation, identified in Table 5.4-1. Of that, mitigation for loss of habitat and habitat connectivity (#3) consists of creating 154.8 acres of tidal perennial habitat and 3.04 linear miles of channel margin habitat suitable for winter-run Chinook salmon, as detailed below. Another 1.26 linear miles of channel margin habitat creation is designated as mitigation for operational take (#3) of restored riparian bench habitat impacted by NDD operations. Habitat-based mitigation for the existing south Delta diversion facilities (#4) is already included in the environmental baseline (see Table 1-2 *SWP Facilities and Activities Included and Not Included in the Proposed Project*), and consists of mitigation described in the CDFG (2012) consistency determination.

5.4.4.2 Tidal Perennial and Channel Margin Habitat Restoration

Central Valley spring-run Chinook salmon would be subject to exactly the same habitat-based mitigation measures as described in Section 5.4.3.2 *Tidal Perennial Habitat Restoration,* Section 5.4.3.3 *Channel Margin Habitat Restoration*, and Section 5.4.3.4 *South Delta Habitat Restoration*. Due to differences between the two species in exposure, primarily related to seasonal differences in life histories, the mitigation measures would differ somewhat in effectiveness, as described in Section 4.4 *Effects on Spring-run Chinook Salmon*. Measures have been designed with the needs both Chinook salmon species in mind and thus are intended to benefit both species.

5.4.5 California Tiger Salamander

5.4.5.1 Compensation for Effects

DWR will protect California tiger salamander habitat at a ratio of 3:1 (protected to lost) at locations subject to the written approval of CDFW. The newly protected land(s) will be adjacent to or near existing, protected, occupied aquatic and upland habitat. The newly protected lands will have a conservation easement, a management plan approved by CDFW in writing, and an endowment, or similar funding mechanism, to fund management in perpetuity. California tiger salamander habitat protection will be located in the Byron Hills area, west of the project area.

While there is no recovery plan available for California tiger salamander to inform the location of conservation lands, conservation in this area will benefit the California tiger salamander by protecting habitat in a region where high-quality habitat and extant occurrences are known to exist. Grasslands selected for protection will be located near important areas for conservation that were identified in the *East Contra Costa County HCP/NCCP* (East Contra Costa County Habitat Conservancy 2006) (not all of which will be acquired by that plan) and will include appropriate upland and aquatic features, e.g., rodent burrows, stock ponds, intermittent drainages, and other aquatic features, etc. An estimated 50 acres of habitat will be affected (47 acres within the construction footprint and 3 acres adjacent to construction, potentially subject to vibration); therefore, under a 3:1 mitigation ratio, 150 acres of habitat will be protected (Table 5.4-3).

Table 5.4-3. Compensation for Direct Effects on California Tiger Salamander Habitat.

	Maximum Total Impact (Acres)	Habitat Protection Compensation Ratio	Total Habitat Protection if all Direct Impacts Occur (Acres)
Terrestrial cover and aestivation	50	3:1	150
Total	**50**	**-**	**150**

5.4.5.2 Siting Criteria for Compensation for Effects

Grasslands, associated vernal pools, and alkali seasonal wetlands will be protected in perpetuity as compensation for effects on California tiger salamander. Land acquisition for California tiger salamander grassland habitat management lands will be prioritized based on the following characteristics:

- Large contiguous landscapes that consist of grasslands, vernal pool complex, and alkali seasonal wetland complex and encompass the range of vegetation, hydrologic, and soil conditions that characterize these communities.

- Lands that maintain connectivity with protected grassland, vernal pool complex, and alkali seasonal wetland complex landscapes near the project area, including connectivity with lands that have been protected or may be protected in the future under the East Contra Costa County HCP/NCCP.

- Grasslands containing stock ponds and other aquatic features that provide aquatic breeding habitat for California tiger salamander.

- Adjacent or connected to occupied upland or aquatic habitat.

5.4.5.3 Management and Enhancement

The following management and enhancement activities will be implemented on grasslands protected to benefit California tiger salamander.

- Maintain hydrology and water quality. Hydrologic functions to be maintained within vernal pool and alkali seasonal wetland complexes include surface water storage in the

pool, subsurface water exchange, and surface water conveyance (Butterwick 1998:52). Aspects of surface water storage such as timing, frequency, and duration of inundation will be monitored, enhanced, and managed to benefit California tiger salamander. Techniques used to enhance and manage hydrology may include seasonal draining, invasive plant control, removal of adverse supplemental water sources into reserves (e.g., agricultural or urban runoff), and topographic modifications. Any pesticides used for invasive plant control will be applied during the dry season (typically between July 15 and October 15) when ponds and other aquatic features are not inundated. Disking or mowing will not be used to control vegetation in California tiger salamander habitat.

Repairs may be made to improve water retention in stock ponds that are not retaining water due to leaks and, as a result, not functioning properly as habitat for California tiger salamander. Additionally, pond capacity and water duration may be increased (e.g., by raising spillway elevations) to support California tiger salamander populations. To the greatest extent practicable, repairs will be implemented outside the California tiger salamander breeding season to minimize effects on the species[15].

To retain the habitat quality of stock ponds over time, occasional sediment removal may be needed to address the buildup of sediment that results from adjacent land use or upstream factors. Sediment removal will only be conducted during the nonbreeding periods for California tiger salamander to minimize impacts on the species.

- Control nonnative predators. Habitat management and enhancement will include trapping and other techniques to control the establishment and abundance of bullfrogs, barred tiger salamander, and other nonnative predators that threaten wildlife species in vernal pools, seasonal wetlands, and stock ponds. DWR, as project applicant, or the land manager will work to reduce and, where possible, eradicate invasive species that adversely affect native species. These efforts will include prescribed methods for removal of bullfrogs, mosquitofish, and nonnative predatory fish from stock ponds and wetlands in the habitat management lands, including limiting the hydroperiod of stock ponds.

  The designated land manager will work to reduce, and if possible eradicate, nonnative predators (e.g., bullfrogs, barred tiger salamander, nonnative predatory fish) from aquatic habitat for covered amphibian species through habitat manipulation (e.g., periodic draining of ponds), trapping, hand-capturing, electroshocking, or other control methods. These activities will be carried out by qualified biologists familiar with California tiger salamander, and will be conducted in a manner that avoids take of California tiger salamanders. Draining ponds annually, sterilizing or removing subsoil, and removing bullfrogs can be effective at reducing predation by bullfrogs and other invasive species on covered amphibians and reptiles (Doubledee et al. 2003). Some ponds in the habitat management lands might be retrofitted with drains if the nonnative species populations cannot be controlled by other means. Ponds without drains and that do not drain naturally may need to be drained annually using pumps. Drainage of stock ponds and other wetlands will be carried out during the summer or fall dry season. Models predict that

[15] Maintaining California tiger salamander use of stock ponds on livestock ranches for breeding appears to be a critical link in the conservation and recovery of this species.

draining ponds every 2 years will decrease the likelihood that bullfrogs will persist in ponds (Doubledee et al. 2003). Limiting the hydroperiod of stock ponds also shifts the competitive balance from nonnative barred tiger salamander and hybrid salamanders in favor of native California tiger salamanders (Johnson et al. 2010).

- Maintain or enhance burrow availability. Ground-dwelling mammals such as California ground squirrel provide burrows for California tiger salamander. Historically, ground squirrel populations were controlled by ranchers and public agencies. Eliminating ground squirrel control measures on habitat management lands may enable increased squirrel populations in some areas. However, some rodent control measures will likely remain necessary in certain areas where dense rodent populations may compromise important infrastructure (e.g., pond berms, road embankments, railroad beds, levees, dam faces). The use of rodenticides or other rodent control measures will be prohibited in habitat management lands except as necessary to address adverse impacts on essential structures in or immediately adjacent to these lands, including recreational facilities. DWR or the land manager will introduce livestock grazing as appropriate (where it is not currently used, and where conflicts with worksite activities will be minimized) to reduce vegetative cover and thus encourage ground squirrel expansion and colonization.

- Manage livestock grazing. Grazing by livestock and native herbivores is proposed to manage grassland vegetation and thatch to facilitate dispersal of California tiger salamander, for which dense vegetation may hinder movement. Appropriate grazing programs will be developed for enhancing and maintaining habitat for California tiger salamanders based on site-specific characteristics of the community, the spatial location of important ecological features in each pasture, the history of grazing on the site, species composition of the site, grazer vegetation preference, and other relevant information. Grazing exclusion (areas excluded from grazing) will be used as a management alternative where appropriate.

5.4.6 Giant Garter Snake

5.4.6.1 Compensation for Effects

DWR will identify suitable habitat during project implementation as described in Section 5.3.6.1 *Suitable Habitat Definition.* Where identified and delineated giant garter snake habitat cannot be avoided, compensation for the loss of the habitat will occur at a ratio of 3:1 for each, aquatic and upland habitat, with in-kind habitat type compensation (Table 5.4.6-1). An estimated 775 acres of giant garter snake habitat will be affected, therefore 2,325 acres of giant garter snake habitat will be protected or restored. If the site-specific habitat analysis finds that less or more suitable habitat will be impacted than estimated using the model, DWR will seek to amend the permit to adjust mitigation requirements and take limits as needed. Insofar as mitigation is created/protected in a USFWS agreed-to high-priority conservation area, such as the eastern protection area between Caldoni Marsh and Stone Lakes, a mitigation rate of 2:1 for each, aquatic and upland habitat type, will apply which may lower the above example to 1,550 acres of mitigation. A combination of in-kind and high-priority mitigation may be used.

- Giant garter snake upland mitigation will be placed and protected adjacent to aquatic habitat protected for giant garter snake. The upland habitat will not exceed 200 feet from protected aquatic habitat (unless research shows a larger distance is appropriate and CDFW and USFWS agree).

- Incidental injury and/or mortality of giant garter snakes within protected and restored habitat will be avoided and minimized by establishing 200-foot buffers between protected giant garter snake habitat and roads (other than those roads primarily used to support adjacent cultivated lands and levees).

- Protected and restored giant garter snake habitat will be at least 2,500 feet from urban areas or areas zoned for urban development.

- Characteristics of restored and protected habitat may change from the above descriptors if new information and best available science indicate greater benefits as agreed upon by USFWS.

Table 5.4.6-1. Compensation for Direct Effects on Giant Garter Snake Habitat

	Permanent Habitat Loss	Compensation Ratios		Total Compensation	
	Total Maximum Habitat Loss (Acres)	Protection	Restoration	Protection[2]	Restoration[2]
Aquatic Total	205	3:1 or 2:1[1]		615 or 410	
Upland Total	570			1,710 or 1,140	
TOTAL	775			2,325 or 1,550	

[1] The 3:1 mitigation ratio will be applied when "in-kind" mitigation is used. In-kind mitigation is that mitigation that replaces a habitat of similar quality, character, and location as that which was lost within the known range of the giant garter snake as described in Section 2.6.5, *Suitable Habitat Definition*. DWR will mitigate at a rate of 2:1 for each acre of lost aquatic and upland habitat if the mitigation is created/protected in a high-priority conservation location for GGS, approved in writing by CDFW and USFWS, such as the eastern protection area between Caldoni Marsh and Stone Lakes. All restoration lands will meet a 2:1 upland to aquatic habitat design criteria.

[2] Compensation can be achieved through restoration or protection. The protection component of habitat compensation will be limited to up to 1/3 of the total compensation.

5.4.6.1.1 Siting Criteria for Compensation for Effects

Siting and design requirements for the restoration and protection of giant garter snake nontidal wetland habitat are listed below.

- For in-kind mitigation sites (those site mitigated at a ratio of 3:1), the aquatic and upland habitat quality, character, and location must be of equal or greater value than the habitat quality which was lost.

- For conservation mitigation sites (those sites mitigated at a 2:1 ratio), restored or protected giant garter snake habitat will either be adjacent to, or connected to, Caldoni Marsh or the White Slough Wildlife Area, or will create connections from the White Slough population to other areas in the giant garter snake's historical range in the Stone Lakes vicinity or at another location, or corridors between these areas, to be selected by DWR, subject to written approval from CDFW and USFWS. The connections may be marsh, rice fields, or irrigation or other canals that facilitate giant garter snake dispersal.

- Mitigation sites mitigated at a 2:1 ratio will be characterized as nontidal marsh and will meet the following design criteria: Restored or protected nontidal marsh will be characterized by sufficient water during the giant garter snake's active summer season (May 1–October 1) to supply constant, reliable cover and sources of food such as small fish and amphibians.

- Restored or protected nontidal marsh will consist of still or slow-flowing water over a substrate composed of soil, silt, or mud characteristic of those observed in marshes, sloughs, or irrigation canals.

- Restoration designs will not create large areas of deep, perennial open water that will support nonnative predatory fish. The restored marsh will be characterized by a heterogeneous topography providing a range of depths and vegetation profiles consisting of emergent, herbaceous aquatic vegetation that will provide suitable foraging habitat and refuge from predators.

- Aquatic margins or shorelines will transition to uplands consisting of grassy banks, with the dense grassy understory required for sheltering. These margins will consist of approximately 200 feet of high ground or upland habitat above the annual high water mark (highest level to which water rose that year) to provide cover and refugia from floodwaters during the dormant winter season.

- The upland habitat will have ample exposure to sunlight to facilitate giant garter snake thermoregulation and will be characterized by low vegetation, bankside burrows, holes, and crevices providing critical shelter for snakes throughout the day. All giant garter snake upland and aquatic habitat will be established at least 2,500 feet from urban areas or areas zoned for urban development.

The loss of tidal aquatic habitat for giant garter snake may be mitigated through restoration of tidal habitat, provided it meets the following design criteria. These design criteria are necessary to ensure that the tidally restored areas contributing to giant garter snake conservation provide functional habitat for the species.

- The restored wetlands will provide sufficient water during the active summer season (May 1 – October 1) to supply constant, reliable cover and sources of food (e.g., small fish and amphibians) for giant garter snake.

- The restored wetlands will be designed to mute or reduce flows; provide still or slow-flowing water over a substrate composed of soil, silt, or mud characteristic of those observed in marshes, sloughs, or irrigation canals; and avoid fast-flowing water over sand, gravel, or rock substrate.

- The restored wetlands will be designed (e.g., through grading) to facilitate extended hydroperiods in shallow basins that experience only small, gradual (i.e., slower than tidal flooding/draining) changes in inundation. Design features may include notched or lowered levees that prevent full draining during low tides, intertidal dendritic channels

with variable bottom elevations, and other features that retain water such as potholes, ponds/pannes, and shallow isolated backwaters.

- The restored wetlands will not include large areas of deep, open water that will support nonnative predatory fish.

- The restored wetlands will be characterized by a heterogeneous topography that provides the range of depths and vegetation profiles (i.e., emergent, herbaceous aquatic) required for suitable foraging habitat and refuge from predators at all tide levels.

- The restored wetlands will be designed to provide adjacent terrestrial refuge—grasslands above the high water mark—for giant garter snake.

Topography of the restored wetlands will be designed to provide adjacent terrestrial refuge persisting above the high water mark. Terrestrial features will be sited in close proximity to aquatic foraging areas at all tide levels, with slopes and grading designed to avoid exposing largely denuded intertidal mud flats during low tide.

5.4.6.1.2 Management and Enhancement

The following management actions will be implemented for giant garter snake habitat to be protected or restored. If a mitigation bank approved by CDFW and USFWS is used to fulfill the restoration requirement, then the management and enhancement that is in place for that mitigation bank will suffice.

- Manage vegetation density (particularly nonnatives such as water primrose) and composition, water depth, and other habitat elements to enhance habitat values for giant garter snakes.

- Maintain upland refugia (islands or berms) within the restored marsh.

- Maintain permanent upland habitat at least 200 feet wide around all restored nontidal freshwater emergent wetland habitats to provide undisturbed (uncultivated) upland cover, basking and overwintering habitat immediately adjacent to aquatic habitat.

- Manage bank slopes and upland habitats to enhance giant garter snake use, provide cover, and encourage burrowing mammals for purposes of creating overwintering sites for giant garter snake.

5.4.7 Swainson's Hawk

See Section 4.7 *Take of the Swainson's Hawk* for definitions of nesting habitat terms used to inform the Swanson's hawk take analysis, avoidance and minimization measures, and compensation.

5.4.7.1 Compensation for Effects

Mitigation through restoration and protection of Swainson's hawk habitat are described below and in Table 5.4.7-1.

- Swainson's hawk nesting habitat that meets Swainson's hawk suitable habitat criteria (see Section 2.7.5 *Suitable Habitat Definition*) will be restored at a ratio of 1:1 (restored: impacted) and protected at a ratio of 1:1 (protected: impacted) at a location agreed upon in writing by CDFW at that time. Based on anticipated impacts, 23 acres of Swainson's hawk nesting habitat will be restored and 23 acres of existing habitat will be protected.

- Swainson's hawk foraging habitat will be protected at a ratio of 1:1 at locations subject to CDFW approval, within 3 miles of a known Swainson's hawk nest tree and within 50 miles of the project footprint. Protected foraging habitat will have land surface elevations equal to or greater than -1 foot NAVD88 to minimize the risk of flooding and loss of suitable habitat due to future sea level rise. Cultivated lands will be maintained in non-permanent crop types as follows:

    - At least 37.5% of Swainson's Hawk mitigation lands will be in Very High Value foraging habitat on an annual basis.
    - The amount of Very High Value habitat used for mitigation will increase to at least the amount lost to project activities, if it is more than 37.5%.
    - At least 25% of Swainson's Hawk mitigation lands will be in High Value foraging habitat and other grasslands managed for SWHA use on an annual basis.
    - No more than 15% of Swainson's Hawk mitigation lands will be in Low Value foraging habitat on an annual basis.
    - No Swainson's Hawk mitigation lands will be in No Value foraging habitat.

  See Table 2.4 in Section 2.7.4 *Species Habitat Suitability Model*, for definitions of Swainson's hawk foraging habitat value. Mitigation acres will be provided at a 1:1 mitigation ratio for all acres of habitat lost in the Very High, High, Medium, and Low value classes.

- Based on anticipated impacts, 3,791 acres of foraging habitat will be protected.

Table 5.4.7-1 Compensation for Direct Effects on Swainson's Hawk Habitat

Swainson's Hawk Modeled Habitat	Permanent Habitat Loss	Compensation Ratios		Total Compensation (Acres)	
	Total Maximum Habitat Loss (Acres)	Protection	Restoration	Protection	Restoration
Foraging	3,769	1:1	0	3,769	0
Nesting	22	1:1	1:1	22	22
Total	**3,791**			**3,791**	**22**

To compensate for the loss of nest trees and minimize the temporal loss of suitable Swainson's hawk nesting habitat, mature trees will be transplanted and tree saplings will be planted as described in the measures below. Planting larger, mature trees, including transplanting trees scheduled for removal, and supplemented with additional saplings, is expected to accelerate the development of potential replacement nest sites, offset the temporal loss of habitat, and compensate for the impact on Swainson's hawk populations in the Delta.

5.4.7.2 Compensation for Lost Nest Sites

To compensate for the temporal loss off available Swainson's hawk nest sites (defined as a 125-acre area where more than 50% of suitable nest trees [20 feet or taller] within the 125-acre block are removed), five mature native trees (at least 20 feet in height) will be transplanted to an appropriate location; see Section 4.7 *Take of the Swainson's Hawk* for a more detailed definition of this term). Mature trees can be replaced with either nursery stock or trees transplanted from construction sites. To determine the number of replacement trees required, a grid of 125-acre blocks will be placed over each component of project footprint in which trees are to be removed (Figure 4.7-39). The grid will be overlain in a manner that places the most complete squares of the grid in the project footprint (i.e., the grid will be adjusted so that, to the extent possible, entire squares rather than portions of squares will overlap with the project footprint). For a description of this method see Table 4.B-2 in Section 4.B.4.4 *Summarizing Effects on Wildlife and Plants*.

In addition, where mature trees are transplanted, 15 five-gallon-container size native trees suitable for Swianson's hawk nesting will be planted at each mature tree replacement/protection site to provide longevity to the nest site. The expectation is that even if the primary tree planted or transplanted dies prematurely, one or more of the container stock trees will survive and continue to provide nesting habitat for Swainson's hawk.

- Replacement nest sites must be ½ mile or more apart and must be at least ½ mile from active nest trees. Additionally, replacement nest sites must be at least ¼ mile from a *likely potential nest tree,* defined as a tree at least 40 feet in height[16]. These minimum distances may vary on a case-by-case basis with written approval from CDFW.

- The trees will be transplanted as close as biologically feasible to the affected nest site (e.g., near the newly constructed intake facilities), unless such location would have low long-term conservation value due to factors such as threat of ongoing disturbance, seasonal flooding or sea level rise.

- The mature trees will be planted at locations that support suitable foraging habitat conditions for Swainson's hawk. This could be near project facilities (while taking into consideration potential effects of noise and visual disturbance from facility operation), on protected cultivated lands or grasslands, on other existing conservation lands, or on existing DWR lands, as long as the DWR controls the property.

[16] This is based on the average height of nest trees in the region being 47.6 feet, personal communication from Jim Estep in an email dated March 4, 2016.

- DWR may substitute transplanting of mature nest trees with protection of three suitable nest trees for each mature nest tree that would be transplanted.

- To reduce temporal impacts resulting from the loss of mature nest trees, the plantings described above will occur before or concurrent with the removal of trees for construction.

5.4.7.3 Compensation for Lost Known and Potential Nest Trees

For each known and potential nest tree removed for the project, five native trees (five gallon container size) suitable for use for Swainson's hawk nesting will be planted to replace lost suitable nest trees. Suitable nest trees are trees of any species greater than 20 feet tall. The replacement trees will be planted at the following locations; with the mature trees to recreate nest sites; within conserved foraging habitat to increase nest sites, and or within riparian restoration sites.

The survival success of the mature replacement trees and the five-gallon container saplings will be monitored annually and maintained for a period of 10 years to assure survival and appropriate growth and development. Success will be measured as an 80% survival rate at 5 and 10 years after planting. Plantings will subsequently be monitored every 5 years to verify their continued survival and growth. For every tree lost during the 10-year time period, a replacement tree will be planted immediately upon the detection of failure. All necessary planting requirements and maintenance (i.e., fertilizing, irrigation) to ensure success will be provided. Trees will be irrigated for a minimum of 5 years after planting, and then gradually weaned off the irrigation during a period of approximately 2 years. If larger stock is planted, the number of years of irrigation will be reduced accordingly. If the 80% establishment success criterion cannot be met, protection of three mature nest trees can substitute for each failed nest tree transplant.

5.4.7.4 Install Bird Strike Diverters on Existing Transmission or Distribution Lines

To mitigate for the effects of bird strikes on transmission lines installed under the PP, bird strike diverters will be placed on existing lines. The length of existing line to be fitted with bird strike diverters will be equal to the length of new permanent and temporary transmission lines constructed as a result of the project. If new transmission lines replace existing transmission lines, no additional diverters on existing lines will be required. The diverters will be spaced along the lines in accordance with the Avian Powerline Interaction Committee's guidance (Avian Power Line Interaction Committee 2012). Bird strike diverters installed in this manner are expected to reduce bird strike risk by at least 60%. Bird strike diverters will be periodically inspected and replaced as needed until or unless the project or existing line is removed, or are otherwise no longer a strike risk for Swainson's hawk.

5.4.7.5 Siting Criteria for Land Acquisition

Fields that are at least 40 acres will be protected as this size of foraging patch will be more likely noticed by Swainson's hawks than smaller parcels, and will maintain higher densities of prey. Grassland and other natural lands may be protected in patches smaller than 40 acres.

5.4.7.6 Management and Enhancement

The following management activities will be implemented in grassland and cultivated lands to benefit Swainson's hawk and will be required for compensation lands.

5.4.7.6.1 Grassland

The use of rodenticides or other rodent control measures will be prohibited on protected grasslands except as necessary to address adverse impacts on essential structures in or immediately adjacent to reserves, including recreational facilities that are part of the PP. DWR will introduce livestock grazing (where it is not currently used) to reduce vegetative cover and thus encourage ground squirrel expansion and colonization. Burrow availability may also be increased on protected grasslands by encouraging ground squirrel occupancy through the creation of berms, mounds, edges, and other features designed to attract and encourage burrowing activity. The introduction of ground squirrel colonies will be considered when the natural recruitment of ground squirrels does not occur on protected or restored grasslands. The introduction of ground squirrels will be overseen by an Approved Biologist and will be approached in an experimental way given the mixed success with which it has been implemented in the past. Site conditions such as soils will be assessed for the potential for relocation success. Site pre-treatment and "soft release" methods will be considered to increase the potential for success.

Where lands neighboring protected grasslands require ground squirrel management to protect agricultural uses or public health, a buffer zone will be established within which ground squirrel colonies will not be encouraged. The width of this buffer will be determined by the manager of the protected lands in consultation with neighboring landowners and DWR scientists. The buffer width will depend on site conditions, the size and density of the local ground squirrel population, and the intensity of control methods used adjacent to protected lands.

5.4.7.6.2 Cultivated Lands

The distribution and abundance of potential Swainson's hawk nest sites in the Delta will be increased by planting and maintaining native trees along roadsides and field borders to achieve a rate of one tree per 10 acres of protected cultivated lands.

The establishment and sustainability of Swainson's hawk prey populations will be supported by establishing 20- to 30-foot-wide hedgerows along field borders and roadsides at a minimum rate of 400 linear feet per 100 acres of protected cultivated lands.

Tree rows, wood lots or other tree groves, and isolated trees will also be retained under conservation easements on cultivated lands to provide nesting habitat for Swainson's hawk. Small woodlots may also be planted in field corners or tree rows may be planted along field borders to provide nesting habitat for these species.

5.4.8 Tricolored Blackbird

5.4.8.1 Compensation for Effects

Mitigation measures for impacts on tricolored blackbird are described below and in Table 5.4.7-1.

- Suitable tricolored blackbird nesting habitat will be permanently protected or restored and managed at a ratio of 3:1 (protected or restored: impacted) at a location subject to CDFW approval, and in close proximity to the nearest breeding colony observed within the past 15 years if possible. Nesting habitat will be managed to provide young, lush stands of bulrush/cattail emergent vegetation and prevent vegetation senescence; or other nesting substrate determined to be location and use appropriate and agreed to by CDFW. Based on an estimated 16 acres of impact, 48 acres of nesting habitat will be protected or restored.

- Breeding season foraging habitat will be protected at a ratio of 1:1 at a location subject to CDFW approval within six kilometers of 1) protected or restored nesting habitat that is managed for tricolored blackbird or 2) recently or historically (to encourage recolonization) occupied tricolored blackbird nesting habitat. To allow for normal crop rotation, 50 percent of land protected as tricolored blackbird breeding foraging habitat must be planted in high- and very high-value crop types in any given year (see Table 5.4.8-2 below for definitions of foraging habitat quality). As a result of impacts, 2,063 acres of breeding-foraging habitat will be protected.

- Nonbreeding season foraging habitat will be protected at a ratio of 1:1 at a location subject to CDFW approval. At least 50 percent of these protected areas must be kept in high-and very-high value crop types. Based on the impacts, 1,774 acres of nonbreeding foraging habitat will be protected, with at least 887 acres managed as high or very high-value habitat.

- Roosting habitat will be protected or restored at a ratio of 1:1 if not occupied, and a ratio of 2:1 if occupied by tricolored blackbirds.

- Small patches of important wildlife habitats associated with cultivated lands that occur in cultivated lands within the reserve system will be maintained, including isolated valley oak trees, trees and shrubs along field borders and roadsides, remnant groves, riparian corridors, water conveyance channels, grasslands, ponds, and wetlands.

- On cultivated lands managed as high- to very high-value foraging habitat for tricolored blackbirds, insecticide use will be minimized to the greatest extent practicable during the spring growing season until tricolored blackbird nestlings have fledged or it is documented that no nearby nesting is occurring. This is to ensure that an abundant insect prey population is available to support egg development and feeding of the young, as well as to minimize the risk of pesticide toxicity effects.

Table 5.4.8-1. Maximum Direct Effects on and Conservation of Modeled Habitat for Tricolored Blackbird

Tricolored Blackbird Modeled Habitat	Permanent Habit Loss	Compensation Ratios		Total Compensation (Acres)	
	Total Maximum Habitat Loss (Acres)	Protection	Restoration	Protection	Restoration
Breeding Habitat – Foraging	2,063	1:1	0	2,063	
Breeding Habitat - Nesting	16	3:1		48	
Nonbreeding Habitat –Foraging	1,774	1:1		1,774	
Nonbreeding Habitat - Roosting	20	2:1		40	
Total	**3,873**			**3,925**	

Table 5.4.8-2. Tricolored Blackbird Foraging Habitat Value Classes

Foraging Value Class	Breeding Season Foraging Habitat	Nonbreeding Season Foraging Habitat
Very high	Native pasture, nonirrigated native pasture, annual grasslands, vernal pool grasslands, alkali grasslands, unsprayed alfalfa, unsprayed sunflower, unsprayed mixed alfalfa	Livestock feed lots
High	Sunflower, alfalfa and mixed alfalfa, mixed pasture, induced high water table native pasture, nonirrigated mixed pasture, dairies	Corn, sunflower, millet, alfalfa and mixed alfalfa, mixed pasture, native pasture, induced high water table native pasture, nonirrigated native pasture, rice, dairies, annual grasslands, vernal pool grasslands, alkali grasslands
Moderate	Miscellaneous grass pasture, fallow lands cropped within 3 years, new lands prepped for crop production, livestock feed lots, organic rice	Miscellaneous grass pasture nonirrigated mixed pasture, fallow lands cropped within 3 years, new lands prepped for crop production, organic rice
Low	Wheat, mixed grain and hay, farmsteads, Rice	Wheat, oats, mixed grain and hay, farmsteads

5.4.8.1.1 Siting Criteria for Compensation for Effects

Nesting habitat protection or restoration will be prioritized based on the following characteristics. Alternative nesting habitat can be considered based on best available science (e.g., protection of upland tricolored blackbird nesting habitat including blackberries or some of the other upland vegetation species frequently used by tricolored blackbirds for nesting).

- Occupied or recently occupied (within the last 15 years) stands of bulrush/cattail emergent vegetation.
- Wetland marsh habitat that contains standing water to a depth of 1 foot in most years from late January through late July to encourage dense development of cattail and

bulrush vegetation and to provide protection from predators until nesting is completed; and that is within 6 kilometers of high or very high quality foraging habitat.

Foraging habitat protection will be prioritized based on the following characteristics.

- Large contiguous landscapes that consist of high or very high quality cultivated lands, grasslands, vernal pool complex, and alkali seasonal wetland complex (see Table 5.4.8-1).

- Cultivated lands that incorporate riparian corridors, water conveyance channels, grasslands, and wetlands.

- Cultivated lands that provide opportunities to maintain a mosaic of crop types and allow for the periodic rotation of essential crop types (those crop types with very high, high, and moderate foraging habitat values) to nonessential crop types to ensure acreage commitments (Table 5.4.8-1).

- Cultivated lands that expand upon or provide connectivity between existing conservation lands.

5.4.8.1.2 Management and Enhancement

The following management and enhancement activities will be implemented to benefit tricolored blackbird.

5.4.8.1.2.1 Nesting Habitat Enhancement and Management

Management and enhancement of tricolored blackbird nesting habitat will be consistent with the recommendations provided by Kyle (2011). The following criteria will guide site selection and management of emergent wetland habitat to benefit tricolored blackbird.

- Burn, mow, or graze bulrush/cattail vegetation every 2 to 5 years to remove dead growth and encourage the development of new vegetative structure.

- Maintain large continuous stands of bulrush/cattail that are at least 30 to 45 feet wide to provide adequate space for breeding as well as protection from predators.

- Establish seasonal buffer zones around restored tricolored blackbird nesting habitat to reduce disturbance and improve foraging habitat for tricolored blackbirds.

5.4.8.1.2.2 Associated Features

Where conditions permit, stands of emergent vegetation, native blackberry, or other native vegetation will be established along ditches and canals to provide suitable nesting substrate for tricolored blackbird. These stands will be located near foraging sites and, where feasible, within the dispersal range of existing tricolored blackbird nesting colonies.

5.4.9 Mason's Lilaeopsis

Compensation through restoration of Mason's lilaeopsis habitat is listed below.

- Impacts to Mason's lilaeopsis habitat will be offset through restoration of suitable habitat at a ratio of 1:1 (linear feet protected:linear feet impacted), for a total of 800 linear feet of habitat restoration; additionally, 30 linear feet of habitat will be restored to offset loss of up to 10 linear feet of occupied habitat (Table 5.4.9-1). Restored Mason's lilaeopsis habitat will be a subset of tidal restoration mitigation and sited in areas near extant populations of Mason's lilaeopsis that could provide vegetative or seed propagules. Restored habitat will be sited in locations subject to CDFW approval.

Table 5.4.9-1. Compensation for Direct Effects on Mason's Lilaeopsis Suitable Habitat

	Maximum Total Impact (linear feet)	Habitat Mitigation Ratio	Total Habitat Mitigation if all Direct Impacts Occur (linear feet)
Restoration for Habitat Loss	800	1:1	800
Restoration for Occurrence Loss	10	3:1	30

5.4.9.1 Siting Criteria for Land Acquisition

To the maximum extent possible, restored habitat for Mason's lilaeopsis habitat will be sited to provide optimal conditions for healthy populations of the species to occur in areas which meet the following criteria, which are based on a report by Golden and Fiedler (1991):

- Habitat will be restored on tidally inundated wave-cut beaches or eroding earthen levees (emergent wetlands and mudflats along channel margins) in the Sacramento-San Joaquin Delta.

- Restoration will occur in areas with no riprap (revetment) and little human disturbance including recreational trails and other foot traffic.

5.4.9.2 Habitat Management

Invasive plants such as perennial pepperweed (*Lepidium latifolium*) and water hyacinth (*Eichhornia crassip*es) will be controlled as necessary in protected tidal wetlands. Perennial pepperweed will be limited to no more than 10 percent cover in protected tidal wetlands. While methods have been developed to reduce the cover of invasive species in the short term, there are no long-term control solutions and effective management of invasive plant species will require an uninterrupted long-term commitment. Control methods may include hand or mechanical removal, spot application of herbicides, controlled burn, or targeted grazing.

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